DOCUMENT RESUME

ED 093 596 SE 016 911

TITLE	Knowing and Using Your Environment. Environmental Education Curriculum.
INSTITUTION	Topeka Public Schools, Kans.
SPONS AGENCY	Bureau of Elementary and Secondary Education (DHEW/OE), Washington, D.C.
PUB DATE	Mar 73
NOTE	173p.
EDRS PRICE	MF-$0.75 HC-$7.80 PLUS POSTAGE
DESCRIPTORS	Curriculum Guides; *Ecological Factors; *Ecology; *Environmental Education; *Geology; Intermediate Grades; Natural Resources; Natural Sciences; Recreation; *Water Resources
IDENTIFIERS	*Elementary Secondary Education Act Title III; ESEA Title III

ABSTRACT

This unit is intended to help students become aware of overall relationships and interactions that exist between the various segments of the environment. The unit consists of four topics: (1) Geology--The geological history of the earth as illustrated by fossils; (2) Plants and Animals--the role and interactions of plants and animals in the environment; (3) Rivers and Reservoirs--the uses, patterns, and locations of rivers and reservoirs in Kansas; and (4) Archery--an example of a nondestructive recreational use of the environment. For each topic there are behavioral objectives, student activities, and teacher suggestions. Teaching aids are found in the appendix. (JP)

environmental education curriculum

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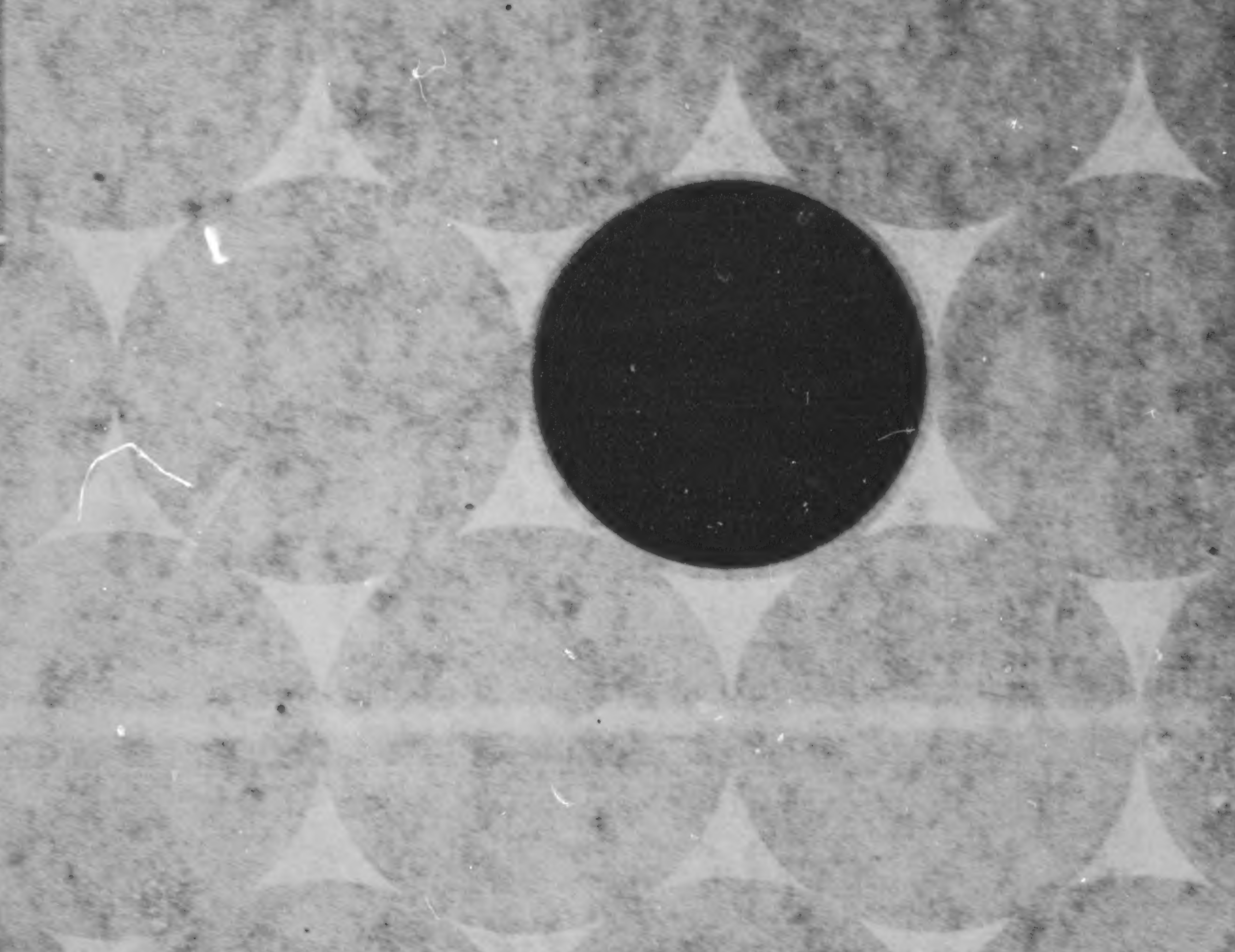

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ENVIRONMENTAL EDUCATION PROJECT
ESEA TITLE III, SECTION 306

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A unit developed by the Outdoor-Environmental Education Project Staffs, March, 1973, for intermediate level elementary school students.

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KNOWING AND USING
YOUR
ENVIRONMENT

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FOREWORD

This unit is intended to help students become aware of overall relationships and interactions that exist between the various segments of the environment. The unit consists of four topics: 1) Geology - the geological history of the earth as illustrated by fossils; 2) Plants and Animals - the role and interactions of plants and animals in the environment; 3) Rivers and Reservoirs - the uses, patterns, and locations of rivers and reservoirs in Kansas; and 4) Archery - an example of a nondestructive recreational use of the environment. Teaching aids and resource material found in the appendix supplement each topic.

The unit activities are only suggested as examples of possible approaches to be used to meet the unit goals and objectives. Modify the activities to meet the abilities and interest of each class. Teachers are not expected to teach all the activities. The following activities are recommended as the minimum that could be taught to accomplish the unit objectives:

Topic I - Geology 1.2, 1.5, 1.7, 1.8, 1.10, 1.14, 1.16.

Topic II - Plants and Animals 2.2, 2.4, 2.5, 2.6, 2.9, 2.10, 2.13, 2.16, 2.18.

Topic III - Rivers and Reservoirs 3.1, 3.3, 3.4, 3.5.

Topic IV - Archery 4.1, 4.2, 4.3, 4.5, 4.7.

It is hopeful this unit will help to establish in students an appreciation and understanding of the environment necessary for them to make intelligent decisions regarding the environment both now and in the future.

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ACKNOWLEDGMENT

The Environmental Education Project for the Topeka Public and Parochial Schools began operation June 29, 1971. The following individuals deserve recognition for the interest, time, and devotion they gave during the difficult stages of planning and writing the project proposal:

- Mr. John Ganger, Coordinator of Curriculum for Special Education
- Mr. W. I. Green, Director of Special Education
- Dr. Quinton Groves, Director of Health, Physical Education, Safety, and Athletics
- Mr. Clarence "Tuffy" Kellogg, Elementary Physical Education Consultant
- Mr. Stanley Martin, Science Supervisor
- Mr. Claude Ritchie, Principal, Gage Elementary School
- Mr. William Wagaman, Director of Federal Programs
- Dr. Gilbert Wehmeier, Principal, Potwin Elementary School

The needed support and assistance given to the project by Dr. Merle R. Bolton, superintendent of schools, other members of the central administrative staff, the instruction department, personnel office, business office, data processing department, maintenance department, and William Wagaman, director of federal programs, is gratefully acknowledged.

Special recognition is given to the Topeka Public School's Board of Education, who approved and is supporting this creative, exemplary, and innovative federally funded project.

My sincere gratitude is extended to the project's program specialists for their tireless efforts in developing this elementary unit. Curriculum development and revision has extended the working days for these staff members. My personal thanks are given to Glenn Clarkson, Thad Whiteaker, and Bob King for an outstanding job.

Mrs. Barbara Stanley and Mr. C. L. "Tuffy" Kellogg must receive special thanks for providing leadership and assistance in the development of this unit and for conducting the many field trips.

With the deepest appreciation, I acknowledge the work of the secretarial team. The constant revision, pressures, deadlines, and demands for quality work were handled in a most outstanding manner by Dorothy Booher, Sandy Holmes, Rita Dreiling, and Mary Hoy. Special thanks go to Annie Vickers, a faithful volunteer!

Donald French

Donald French
Project Coordinator

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UNIT GOALS AND OBJECTIVES

The study of this unit, "Knowing And Using Your Environment," will accomplish the following goals:

1) Develop student appreciation and awareness of the environment in which they live.

2) Develop student knowledge and awareness about the earth's geological history.

3) Develop student knowledge about local geology as illustrated by Calhoun Bluffs.

4) Increase the student's appreciation and understanding of the ways plants and animals depend on and help each other.

5) Increase the student's ability to observe the various living and nonliving parts of the environment.

6) Develop student knowledge about water movement patterns on the earth.

7) Provide each student an opportunity to interact with and view a natural environment during a field trip experience.

8) Develop knowledge necessary for safe and enjoyable use of a bow and arrow.

These goals are further defined through the use of behavioral objectives. The behavioral objectives establish a predetermined goal toward which learning is to be directed and by which attainment may be measured. This unit is intended to develop student changes in both the cognitive (knowledge) and the affective (attitude) domains. The behavioral objectives for this unit contain: 1) experience designed to develop conditions for achieving the expected behavior (learning activity), 2) the expected criterion (number of students who should achieve the behavior in an average class (80 per cent), 3) the audience for which the behavior is expected (participating students), 4) the method by which the evaluation will occur (multiple-choice) questions), and 5) the expected behavior (selecting the correct answer).

The following behavioral objectives are intended to give teachers direction during the teaching of this unit. The behavioral objectives define only key concepts basic to the entire unit. They do not define all the learning experiences that will occur. The stated behavioral objectives can be used by the classroom teacher to measure student progress toward the overall unit objectives. The objectives will be revised as more student data becomes available. This data will provide information necessary before realistic criterion levels can be calculated.

1) The study of the geology topic will enable 70 per cent of the participating students, on a multiple choice question, to select "pieces of things or indications of past living things" as a definition of fossils.

2) The study of the geology topic will enable 60 per cent of the participating students, on a multiple choice question, to select a choice indicating older rock layers are usually found below more recent rock layers.

Unit Goals and Objectives
(Continued)

3) The study of the geology topic will enable 50 per cent of the participating students, on a multiple choice question, to select "changing conditions on the earth's surface" as a cause of the layering effect of rocks.

4) The study of the geology topic will enable 80 per cent of the participating students, on a multiple choice question, to select a choice indicating the Calhoun Bluffs area was once covered by water as based on the fossils present.

5) The study of the geology topic will enable 90 per cent of the participating students on a multiple choice question, to select a choice indicating that man has been on the earth only a short time compared to the time the earth has existed.

6) The study of the geology topic will enable 50 per cent of the participating students, on a multiple choice question, to select a choice indicating that most animals 250 million years ago were smaller than some of today's animals.

7) The study of the geology topic will enable 70 per cent of the participating students, on a multiple choice question, to select "sedimentary rocks" as the type of rock in which fossils are found.

8) The study of the plant and animal topic will enable 70 per cent of the participating students, on a multiple choice question, to select a choice indicating that plants affect the environment in which they live by affecting the amount of light that reaches the ground, providing the food supply that animals need, and by changing the soil composition.

9) The study of the plant and animal topic will enable 70 per cent of the participating students, on a multiple choice question, to select choices indicating these changes have occurred in Kansas during the last 100 years: trees grow where grass formerly grew, river water is dirtier, and more deer are present.

10) The study of the plant and animal topic will enable 80 per cent of the participating students, on a multiple choice question, to select a choice illustrating examples of how organisms have adapted to live in their present environment.

11) The study of the plant and animal topic will enable 60 per cent of the participating students, on a multiple choice question, to select a choice matching a specific organism (moss, algae, grass, etc.) with the environment in which it will live.

12) The study of the plant and animal topic will enable 70 per cent of the participating students, on a multiple choice question, to select a choice indicating that most seeds or offspring will die or be eaten before they grow into mature plants or animals.

13) The study of the plant and animal topic will enable 80 per cent of the participating students, on a multiple choice question, to select a choice indicating the material in plant and animal bodies will be returned to the soil when the plant or animal dies.

Unit Goals and Objectives
(Continued)

14) The study of the plant and animal topic will enable 60 per cent of the participating students, on a multiple choice question, to select a choice indicating that land plants will die if a basic need is not available.

15) The study of the plant and animal topic will enable 70 per cent of the participating students, on a multiple choice question, to select "green plants" as the producers of all food for animals.

16) The study of the plant and animal topic will enable 80 per cent of the participating students, on a multiple choice question, to select spreading seeds as one way animals help plants.

17) The study of the plant and animal topic will enable 80 per cent of the participating students, on a multiple choice question, to select a choice indicating animals depend on plants for food, oxygen, and shelter.

18) The study of the plant and animal topic will enable 80 per cent of the participating students, on a multiple choice question, to select a choice indicating nonliving factors such as temperature, rainfall, and amount of sunlight affect the plants growing in an area.

19) The study of the plant and animal topic will enable 70 per cent of the participating students, on a multiple choice question, to select a choice indicating decomposers such as mold and bacteria are necessary because they help break dead material down and return its minerals to the soil.

20) The study of the plant and animal topic will enable 70 per cent of the participating students, on a multiple choice question, to select "sunlight" as a basic need of all green plants.

21) The study of the rivers and reservoirs topic will enable 60 per cent of the participating students, on a multiple choice question, to select "acre feet" as the unit used in measuring the amount of water in lakes or ponds.

22) The study of the rivers and reservoirs topic will enable 70 per cent of the participating students, on a multiple choice question, to select a choice indicating flood control, water conservation, and recreation are benefits man gains from reservoirs.

23) The study of the rivers and reservoirs topic will enable 80 per cent of the participating students, on a multiple choice question, to select the "Delaware River" as the river on which the Perry Reservoir is located.

24) The study of the rivers and reservoirs topic will enable 50 per cent of the participating students, on a multiple choice question, to select a choice indicating one or more of the following as factors causing flooding: water draining into the rivers and streams too fast, poor plant cover to slow runoff, and rain for several days in a row.

25) The study of the rivers and reservoirs topic will enable 70 per cent of the participating students, on a multiple choice question, to select a choice indicating the water cycle is necessary because it: 1) moves water across the land from the oceans, 2) prevents all the water from being in one location, and 3) makes water available to plants and animals.

Unit Goals and Objectives
(Continued)

26) The study of the archery topic will enable 80 per cent of the participating students, on a multiple choice question, to select a choice indicating nearly all ages can enjoy archery.

27) The study of the archery topic will enable 50 per cent of the participacing students, on a multiple choice question, to select nine as the value of the bull's eye on an archery target.

28) The study of the archery topic will enable 30 per cent of the participating students, on a multiple choice question, to select "retrieving" as the proper term used to signal the recovering of arrows.

29) The study of the archery topic will enable 80 per cent of the participating students, on a multiple choice question, to select a choice indicating that it is not a safe practice to recover arrows until given the command to do so.

30) The study of the plant and animal topic will enable 70 per cent of the participating students, on a multiple choice question, to select the following ways water is naturally cleaned: action of decomposers, evaporation and condensation, and filtering through the soil.

31) The study of the river and reservoir topic will enable 60 per cent of the participating students, on a multiple choice question, to select "watershed" as the term that describes the area that drains into a given river.

32) The study of the river and reservoir topic will enable 60 per cent of the participating students, on a multiple choice question, to select a choice indicating one or more of the following as examples of changes that occur when a reservoir is built in an area: farmers will move out of the area, new types of wildlife will move into the area surrounding the lake, and new business will develop in the area.

ACTIVITIES SUMMARY SHEET

Topic I. Geology

Activity Number	
1.0	Introduction
1.1	View several rock samples
1.2	Demonstrate a method by which sedimentary rocks could be formed
1.3	Demonstrate a method by which metamorphic rocks can be formed
1.4	Discuss igneous rocks and their formation
1.5	Reviewing the relationship between various types of rocks
1.6	Rock decomposing demonstrations
1.7	Fossil observation
1.8	Develop a definition of fossil
1.9	Develop a picture of an animal
1.10	Discuss how fossils are preserved
1.11	Films that review basic geology concepts
1.12	Interpret Geological Time Charts
1.13	Review with sequence period pictures
1.14	Geological Time Table
1.15	Earth Calendar and Earth Clock
1.16	Calhoun Bluffs Geology

Topic II: Plants and Animals

2.0	Introduction
2.1	Compare living and nonliving material within the environment
2.2	Environmental patterns
2.3	Day and night cycle
2.4	Season Cycle
2.5	Water Cycle
2.6	Air Cycle
2.7	Plant Life Cycle
2.8	Animal Life Cycles
2.9	Food Web
2.10	Matter Cycle
2.11	Earth Cycle Wall Poster
2.12	Review Matter Cycle Using Films
2.13	Variation and Similarity
2.14	Introduction and Discussion of Succession (change)
2.15	Succession on Land
2.16	Succession in a Pond
2.17	Establish a Classroom Terrarium
2.18	Adaptation of Organisms
2.19	Using Plant and Animal Adaptation Pictures
2.20	Man and His Environment
2.21	Man and His Environment Display

Activities Summary Sheet (cont'd)

Activity Number	Topic III: Rivers and Reservoirs
3.0	Introduction
3.1	Kansas River Map
3.2	Missouri River Watershed
3.3	Use of the Kansas Highway Map
3.4	Reservoirs
3.5	Perry Reservoir
3.6	Lakes and Reservoirs in Kansas
3.7	Water Safety
3.8	View the film "Birth of a River"

	Topic IV: Archery
4.0	Introduction
4.1	Archery Equipment (bow and arrow)
4.2	Safety Rules
4.3	Target Shooting Technique
4.4	Bow Practice
4.5	Target Scoring
4.6	Clout Shooting
4.7	Values of Archery
4.8	History of Archery
4.9	Archery Associations

KNOWING
AND USING
YOUR
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TOPIC I: GEOLOGY

1.0
Introduction

1.0
This topic is intended to help students develop an understanding of the changes that are believed to have occurred in the earth's structure and life forms since the formation of the earth. The major goal of this topic is for students to understand that the earth and the life on it are constantly changing shapes and forms. The changes result from the interaction of many factors such as: weather, plants, animals, erosion, and man's activities.

Students should not be expected to remember and use terminology such as the names of fossils or the geological eras, yet you may wish to use such terminology to help convey thoughts, ideas, concepts, and to help relate the relative time of events.

1.1
View several rock samples

1.1
Rocks are the most important material to study to understand the earth's past history. This activity will help students understand that all rocks are not made of the same material. Students will also be able to describe some ways in which rocks are similar and different. By studying the type, content, and location of rocks, within layers, one can imply considerable knowledge about the history of an area.

Have available to students a variety of small rocks. A good sample selection would include: sandstone, shale, limestone, limestone with fossils, slate, quartzite, volcanic cinder, marble, coal, and rock salt. It is not important that you or the students can identify the rock samples by type, but you should be able to identify a variety of characteristics.

Explain to the students they are going to carefully observe the rocks you have and determine something about the rocks' structure. Two or three students can examine each sample. To direct their observation, ask questions such as: 1) Is your rock sample hard or soft? 2) Does your rock sample have layers or lines in it? 3) Does your rock appear to be made of more than one kind of material? 4) Is the rock sample heavy or light? 5) What is unusual about your rock? 6) Is its surface smooth or rough? 7) Does it look old or new?

Prepare students for later activities by developing an interest in learning why the rock samples are different, how were they formed, and are they all the same age. Do not try to develop complete answers, but encourage questioning.

1.2 Demonstrate a method by which sedimentary rocks could be formed.	1.2 After completing several of these activities, students will be able to give at least one explanation of how sedimentary rocks are formed. Fill a wide mouth quart jar two-thirds full of water and then add three handfuls of soil. Other jars could be mixed up using such materials as lime, sand, plaster of Paris, and cement instead of soil to illustrate other types of sedimentary rocks. Shake the mixture for a few minutes, then let is settle. As the students view the jars, ask questions such as: 1) What happened to the material in the water when the water was no longer moving? 2) Why are the layers in the bottom of the jars different? 3) What kind of layer would form if more than one substance was added to one jar? 4) What would happen to the material in the bottom if the water was removed from the jars? Siphon out the water and allow three or four days for the material to dry. The word sediment can be introduced by calling the layer in the bottom sediment. Explain that the rocks formed from layers of sediment are called sedimentary. Can they find any sedimentary rocks in the rock sample they viewed earlier? What common characteristics do the sedimentary rocks have? (layers) Could layers containing plant material like leaves develop? What normally happens to the layers of leaves and dead plants on the ground? What if they did not decay? Can any of the students think of a rock in the samples that could have formed from layers of dead plants? (coal) What must happen to these layers before they can be called rocks? As the layers from the jars dry out, do any of them become hard? What would happen to something that fell into the sediment before the sediment becomes hard?
1.3 Demonstrate a method by which metamorphic rocks can be formed.	1.3 This activity will demonstrate a process by which sedimentary rocks can become metamorphic rock. Metamorphic rocks usually result from sedimentary rocks being subjected to heat and pressure. This demonstration can be performed to illustrate the effect of heat on substances. Although rocks require a considerable amount of time for natural formation, students better understand the process if they can either perform or observe stimulated demonstrations.

1.3 Demonstration of a method by which metamorphic rocks can be formed. (Continued)	1.3 Students will realize after viewing one or more of these demonstrations how heat can cause a substance to change forms. Use a class discussion to relate the observed changes to those changes in nature that change one kind of rock into another. Cut steel wool into fine pieces and mix it with sulfur powder (represents the sedimentary rock). Heat the mixture in either a test tube or a spoon over a burner to cause a reaction. Caution: Do not touch until the material is well cooled. The resulting material will appear different and is comparable to the metamorphic rocks. Heat some egg white and note the change that results. Heat some sugar (very carefully) in a test tube and observe the changes. Bring out the fact nature requires a very long time to change a rock from one kind to another. As layers form on top of other layers, the bottom layers are pressed down. From this pressure, heat is produced and changes sedimentary rocks into metamorphic rocks. Some examples of sedimentary rocks that change into metamorphic rocks are: shale into slate, limestone into marble, sandstone into quartzite. Can the students tell which rock samples available are sedimentary and which are metamorphic rock? After participating in these activities, students will understand that metamorphic rocks result when sedimentary rocks are changed by heat and pressure.
1.4 Discuss igneous rocks and their formation	1.4 Most of the rocks the students observe are either sedimentary or metamorphic, but they will hear about, and occasionally see samples of igneous rocks. The most common igneous rocks found on the earth's surface are the volcanic cinders and granite. Igneous rocks result from metamorphic rocks which are melted as a result of extreme pressure and heat within the earth. When the rocks inside the earth melt, they form magma, a very hot liquid. When the magma reaches the surface, such as during volcanic eruptions, it cools to form solid igneous rocks.

1.5
Reviewing the relationship between various types of rocks.

1.5
Use the rock cycle diagram in appendix B to emphasize the following:

1. The diagram is a general summary and there are many exceptions and details missing from it.
2. Even though rocks do not appear to change when we look at them, they are constantly changing from one shape and type to another.
3. Most rocks require long periods of time to change.
4. Rocks on the earth's surface are constantly breaking up due to the action of weather, water, wind, plants, and animals.
5. Generally sedimentary rocks are formed into metamorphic rocks which are then formed into igneous rocks. When igneous rocks are broken down, they form sedimentary rocks.

1.6
Rock decomposing demonstrations.

1.6
All rocks are constantly undergoing change. This process is normally so slow that students do not realize it is occurring. After viewing or performing some of the following demonstrations, students will better understand how rocks change and the type of activities that bring about this change. At the end of this activity, students will be able to describe at least three ways rocks are decomposed or broken down.

Put water in several baby food jars. Place one small sample of rock in each jar. Use several different types of rock. Be sure to include shale. Have the students observe if any rocks dissolve or break up by being placed in water. Would the rocks that dissolve in water be good for building a house?

Place another set of rock samples in jars containing vinegar. Vinegar is a rather weak acid somewhat similar to acids formed in nature. Natural acids are made: 1) when minerals dissolve in water, 2) when there is an electrical storm, and 3) from the secretions of plant roots. Does the acid cause reactions different than those caused by water?

Have students rub rock samples together to see which rocks will break down through actions of wearing. Wind and water both cause extensive wearing away of rock material. Using the diagram of a rock formation (appendix B) that has been wind eroded, discuss that soft rocks erode or wear away faster. Pass around samples of rocks that have been rounded by movement in water.

Nature also decomposes or breaks up rocks through the action of freezing water. When water freezes it expands. Water in a crack in a rock will push the rock apart a short distance. This can be illustrated by placing a glass container filled with water in a

1.6
Rock decomposing demonstrations. (Continued)

1.6
freezer and observing the amount it expands when it is frozen. Follow this by filling a small medicine bottle with water. Cap it and place in the freezer. Be sure to enclose the bottle within some other container so glass will not get into other materials when it breaks. Assume the bottle was a rock with a crack in it. What would the freezing action do to a rock?

Plant roots have the same effect as freezing when they grow into rocks expanding the cracks. See diagram in appendix B.

Regardless of the method by which a rock is broken down, the fine pieces that result either dissolve in water or become part of the soil. Some of the minerals from the rocks are used by plants for growth. These plants are sources of food for animals. Other parts of the rocks are redeposited to form new sedimentary rocks.

1.7
Fossil observation.

1.7
Much of what we believe to be true about the past condition of the earth and the life that was present before man appeared is based on fossils of various types. During the field trip, students will find and view fossils consisting of shells of past forms of life. They should also realize there are other types of fossils such as leaf prints, preserved tracks, petrified wood, and a few completely preserved animals and plants in tar pits, ice, and amber deposits.

By the end of this activity, students should realize that fossils represent past forms of life. They will also be able to describe at least three types of fossils.

Allow the students time to handle fossils and view the diagrams in appendix B. Do not try to explain what each fossil is, but let the students tell you what they think they are. Ask questions such as: What kind of life do you think produced each fossil? What kinds of conditions must have been present when the plant or animal was alive? What kind of rock's would contain these fossils? These questions will start the students thinking like scientists. Scientists use this type of problem solving to develop geological knowledge.

Allow students time to offer and discuss their ideas about the fossil samples. Do not try to develop specific knowledge about any given fossils, but develop the idea that it is believed past living organisms produced the fossils. Later in the unit, students will gain more knowledge about the kinds of life present when specific fossils were formed.

1.8
Develop a definition of fossil.

1.8
After students have viewed and discussed their impressions of the fossils, develop, by using their ideas, a workable definition for fossils. The definition should be broad enough that it will include any evidence that indicates past forms of life. Explain the pictures we see of dinosaurs and other prehistoric life is the scientists ideas of their shape based on the fossils of plants and animals. It is also based on the shape of our present forms of life.

1.9
Develop a picture of an animal.

1.9
Give each student the diagram of the skeleton (see appendix B) of an animal and have him draw over the skeleton what he thinks the live animal might look like. Emphasize body covering, head shape, coloring, feet, etc. Explain this is the way our present pictures of prehistoric plants and animals were developed by artists and scientists. Could our present pictures have errors?

1.10
Discuss how fossils are preserved.

1.10
By the end of this activity, students will be able to describe two ways in which fossils are formed.

Fossils, such as petrified wood, result from minerals being deposited by water as the wood decayed. The rate of decay is very slow and allows minerals to be deposited in the same pattern as the decaying wood. This is a form of sedimentary rock that develops in an unusual place and way.

Plants and animals that are found in ice, tar pits, and amber have been preserved because the substance they were in did not let decomposers (bacteria, etc.) decay their bodies. This is similar to the methods we use to preserve our food in stores.

The third and most common way fossils are formed is in sedimentary rocks. When animals or plants die, their bodies: 1) fall to the bottom of the oceans, lakes, ponds, or streams; 2) lie on the ground; or 3) are eaten by other organisms. What happens to most of our present plants and animals when they die? Their bodies are eaten therefore, no evidence is left to form fossils for future people to observe. Occasionally, the hard parts (shells and bones) are not eaten and eventually get covered by soil. When the soil hardens to form rocks, the part is preserved within the rock. These rocks would be various sedimentary types (shale, limestone, sandstone, chalk). Examine your rock samples for fossil evidence.

1.10
Discuss how fossils are preserved.
(Continued)

1.10
Bring out the fact that not all sedimentary rocks contain fossils because conditions were not just right at all times and places for fossils to form.

As the sedimentary rocks are eroded, the fossils are exposed (this is what is happening at Calhoun Bluffs). Sometimes the sedimentary rocks are changed into metamorphic rocks. During the change, heat and pressure destroy the fossils, therefore, fossils are not found in metamorphic rocks.

Would plants and animals without bones or shells likely form fossils of any type? Very few fossils exist of the soft bodied plants and animals because they were completely decomposed when they died.

1.11
Films that review basic geology concepts.

1.11
After students have worked with and discussed activities 1.0 through 1.10, the following films can be used as a review and further illustration of the various concepts. Film summaries and discussion questions for each of the suggested films can be found in appendix A. This information is provided so you can select those films you feel will be most useful with your students.

All of these films require teacher guidance so students will understand the significance of the concepts presented.

1) "Rocks That Form On The Earth's Surface"
2) "Rocks That Reveal The Past"
3) "Understanding Our Earth Surface"
4) "Fossils Are Interesting"
5) "Time, Line, and Events"
6) "Understanding Our Earth: Soil"
7) "Prehistoric Times: The World Before Man"
8) "Understanding Our Earth: How Its Surface Changes"
9) "Our Changing Earth"

1.12
Interpret Geological Time Charts.

1.12
The purpose of this activity is to develop a graphic picture of the changes that are believed to have occurred in plants and animals based on fossil evidence.

Do not try to place the various groups of plants or animals into time periods, but develop an understanding of which groups came first and the general trend from simple organisms to more complex.

1.12
Interpret Geological
Time Charts
(Continued)

1.12
As the students are viewing the Geological Time Charts, (see appendix B) emphasize the organisms at the bottom are believed to have been on earth before the organisms at the top of the chart.

The following simple trends can be brought out with the Geological Time Charts: 1) water plants and animals were present before land plants and animals, 2) simple forms were present before complex forms, 3) living forms gradually change, 4) the number of living forms continually increases.

1.13
Review with sequence
period pictures.

1.13
This exercise is a good review to see if the students understand the changes in the types of life from past to present.

Have students view the series of three period pictures (see appendix B) and determine their order from oldest to newest forms of life. Have the students explain their reason for placing them in the order they suggest. Which pictures show mostly water plants and animals? Which picture illustrates plants and animals most like present day forms?

1.14
Geological Time Table

1.14
The geological time table (appendix B) can be used to add a new prospective to the student's knowledge about the past. Up to this point, we have only been concerned with students realizing changes have occured. Now we can develop a better understanding of sequence or order.

Do not be concerned with students learning names of periods, etc., or exact number of years ago.

By the end of this activity, students should realize 1) most life as we know it has been on the earth only a small portion of the earth's history, 2) general types of changes in plant and animals life, and 3) the general geological changes the earth has undergone.

Explain that scientists find it easier to discuss the earth history when they organize it into charts and one type of chart, the geological time table is developed using various types of fossil evidence. The exact dates when past events occured are not known, so some other geological charts students might view may have slightly different dates.

1.14
Geological Time Table
(Continued)

1.14
As you discuss the geological time table, remind the students the bottom represents the oldest and the top the newest.

Emphasize the general change of plant life, animal life, and earth conditions. By the end of the discussion, students should have some understanding for the following sequences from early to present.

Plant life: None → simple bacteria and algae → more complex algae →
simple land plants → fern like plants → cone bearing plants
first flowering plants → modern flowering plants.

Animal life: None → simple one celled water animals → soft bodied
(sponge, jellyfish, worms) → animals without backbones →
fish → amphibians → reptiles → mammals
birds → man.

Earth structure and form: Hot and small → cooled and larger → water appeared →
present form.

While the students are viewing the geological time table, ask questions such as: Did life apparently first appear on land or in water? Were the first plants and animals large or small? Were there flowering plants on the earth when the first fish appeared? Which were on the earth first, mammals or amphibians? What are some types of life that existed in the past, but are not present today? What kind of life was on the land before mammals appeared? Which group of plants when they die help form our coal deposits? (ferns) Do we have any plants or animals still living similar to the early plants or animals? (bacteria and algae) What kind of climate do ferns need in order to live? What is believed to be the condition of the earth during the time it was formed? What has happened to the earth's climate since the earth was formed? Could the changing climate affect the life present on the earth's surface? Has the earth always had the same mountain ranges and seas? What happens to the size of the oceans when large glaciers or ice caps are developed?

End the study of the geological time table relating the period pictures and other pictures the students have to the correct location on the geological time table. This could be used as a bulletin board display with the geological time table in the middle with other pictures surrounding it and connected to the proper portion by colored yarn.

1.14
Geological Time Table
(Continued)

1.14
Point out that the area they will view at Calhoun Bluffs was formed during the Pennsylvanian Period about 250 million years ago.

1.15
Earth Calendar and
Earth Clock

1.15
Students should have a fairly good idea about changes that have occured on the earth since its formation. This activity will develop a better understanding of the relative length of time required for the various changes to occur.

Use either the Earth Clock or the Earth Calendar (see appendix B) to discuss with the students the relative amount of time involved in each period of the earth's history. Both the graphs are based on twelve divisions so they can be discussed in terms of 12 hours or 12 months. Emphasize the relative short amount of time life as we know it has existed and the very small amount of time man has been on the earth.

1.16
Calhoun Bluffs
Geology

1.16
This activity will relate the rock layers and fossils the students will see at Calhoun Bluffs to the complete geological time table and provide details about the fossils they will find.

The Calhoun Bluffs area was formed about 250 million (250,000,000) years ago, and has some of the oldest rocks exposed in Kansas. Have the students guess what kinds of life were probably present when the sedimentary rocks of the Calhoun Bluffs were formed. What kinds of fossils might they expect to find? Remind students that conditions must be "just right" for all kinds of fossils to be formed. They cannot expect to find fossils of all things that were living 250 million years ago.

While the students are viewing the diagram of the Calhoun Bluffs area (appendix B) the following points can be discussed: 1) The different layers resulted from different surface conditions. It is believed that this area at times was under water and at other times it was along the shore line. The thickness of any layer would depend not only on the length of time the conditions stayed the same, but also on what was causing the deposit to form. Have the students name some types of material that could be deposited to form various layers. What type of material might cause the limestone layers? What kind of material might cause the shale layers? 2) The hardness of a rock determines how fast it will erode away. Compare the eroded edge of bluff where the shale layers and limestone layers meet. Which layer, the shale or the limestone, erodes faster?

1.16
Calhoun Bluffs
Geology (Continued)

1.16

Most fossils are harder than the sedimentary rocks in which they are found. During erosion the rock is eroded and the fossils are left on the surface. Fossils that are exposed in this matter are the easiest to collect and will be the ones collected by the students during their field trip. 3) The Kansas River Valley resulted from extensive erosion over many years. Have the students note the level layers of rock. These have resulted from layer after layer being deposited without being distributed by periods of erosion, earthquakes, etc. Once the area became dry, the river valley started eroding and each year the valley gets slightly wider. Where does the eroded soil go?

End this activity with the students understanding the fossils they will collect have come from eroded sedimentary rock that was deposited about 250 million years ago.

2.0
Introduction

2.0
During the study of this topic, students will develop a better understanding of the place of plants and animals within the very large and constant changing system known as the environment. Until students have had special guidance, they tend to view their environment as isolated pieces rather than a complex interrelationship of subsystems. The material in this topic does not try to deal with the environment as one system, but rather as several subsystems each consisting of many living and nonliving pieces, and the interactions of these pieces.

2.1
Compare living and nonliving material within the environment.

2.1
By the end of this activity the students will have developed a working definition of living and nonliving. They will realize that living material is capable of reproducing itself while nonliving material cannot. They will also realize that it is not always easy to decide if material is living or nonliving and living and nonliving material do not exist independently.

The world as it exists today is composed of very complex relationships between its living and nonliving components. Students need to develop enough differentiation between the two that they can work with and understand the movement of matter from one form to the other.

One way to introduce the concept of living and nonliving is to have students name many things (anything they can think of). List the student items on the board. Once the list is fairly large, have the students examine each item as to whether each item is living or nonliving. Indicate the proper categories after the item. At this point, many student reasons may be incorrect, but as they explain their reasons, they will begin to develop a workable definition. The teacher should serve as a director of student ideas, not as a resource. If students are having difficulty distinguishing the item as living or nonliving, do not try to develop a definition until a later time. Definitions that the teacher gives the students may be meaningless to most students. It is much better if they can develop their own based on their thoughts and activities. It may be helpful for some groups to have pictures to observe while discussing living compared to nonliving (See appendix C for sketches).

During the classifying of items, such items as air and water usually do not cause much trouble, but what about a tree leaf or seed? Allow students time to express why they think the seed is living or nonliving.

2.1
Compare living and nonliving material within the environment. (Continued)

2.1
Bring into the discussion the following type of questions. Can a piece of plant be living if it is not connected to the plant? If so, give an example. (flower slips) What happens to a tree leaf during the winter? How does a grain of sand differ from a seed? Can a thing that is living become nonliving? Can a nonliving thing become living? Where do new living things come from? Will all living things some day be nonliving? Can a rock grow? Can a tree grow? Is all of a tree alive? What happens to a baby kitten? Is an animal that is not getting bigger still living? Is a fire living? What do living things need to continue living?

After this series or similar questions, students may wish to group their items into living, nonliving, has lived, and undecided. The undecided group can be referred to later.

At some point, the following generalizations should be developed: 1) living items are able to reproduce themselves (offspring, replace damaged parts, replace worn out parts); 2) that all living organisms die eventually; 3) nonliving materials are used by living organisms; and 4) living material becomes nonliving material when it dies.

2.2
Environmental patterns

2.2
This series of activities is intended to help the students become aware of some patterns that exist within the environment. These patterns are cyclic (are repeated over and over). For this reason, it is worth while to develop what a cycle or circle implies. Use this idea to develop the more complex natural cycles. Some cycles result from the structure of our universe while others are directly related to the material and life present on the earth.

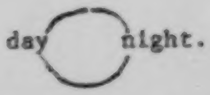
Start a class discussion by drawing a circle on the board or have a large circle cut out. Ask a student to pick a point on the line forming the circle and have him follow the line. As he continues around the circle, emphasize that he returns to the same point he started from. If he continued to follow the line, he would repeat the same path over and over. Is there a starting and stopping place on a circle? Once the students grasp the idea that a circle, if followed, repeats the same path over and over, mention that there are many circles or cycles in their environment and we are going to talk about some of them.

2.3
Day and night cycle

2.3
Can they think of any circles or cycles in their environment? If they have difficulty thinking of any, suggest day and night. This is a familiar cycle to all of them and will allow you to raise some basic ideas of natural cycles. You can illustrate it as a circle

2.3
Day and night cycle
(Continued)

2.3
on the board as

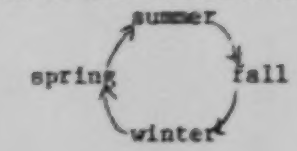


How is day different from night? Which comes first, day or night? What would it be like if there were no more days? What would it be like if there were no more nights? Are our days and nights all the same length? Can you think of places where the days and nights are different lengths than ours? How long does it take to complete one cycle? Do all animals come out in the daytime? Could trees grow if it was always night? What causes day and night? Which is more important, day or night?

Do not develop elaborate descriptions of day and night, but create an awareness that the altering of day and night is a definite part of our environment and life would be different if the cycle was changed.

2.4
Season Cycle

2.4
Another natural cycle they are familiar with is the seasonal change. Sketch a diagram illustrating the four seasons in a cycle:



Following the class discussion of the seasonal cycle, students could collect groups of pictures that illustrate each of the seasons and use them to make a seasonal cycle diagram on the bulletin board. This would not only give the students a better understanding of the seasons, but would start them considering how the environment affects plants and animals.

These suggested questions might be helpful in directing a class discussion.

Is there a spring, summer, fall, and winter all over the world? How are the seasons different in an area like Hawaii compared to our seasons? Which season comes first? How do plants differ during each season? How do animals differ during each season? How do man's activities change with each season? During which season are most wildlife born? During which season do the plants grow the most? When are insects most common? What kind of weather is associated with each season? Can this cycle go backwards? Would life be different if we did not have seasons? What causes the seasons?

2.4
Season Cycle
(Continued)

2.4
Viewing the film "The Seasons of the Year" (summarized in Appendix A) will help students understand plant and animal activities related to each season.

End the discussion of seasonal cycles with students aware that our way of life and the plants and animals in this area would be different if we had a different type of seasonal cycle.

2.5
Water Cycle

2.5
One of the very basic substances present on the earth that allows life to exist as we know it is water. Not only is it important in the life process of plants and animals, but water is also responsible for maintaining a livable temperature on earth. By the end of this activity, students should be able to follow some of the paths taken by water as it moves in and over the earth surface.

In Appendix C is a water cycle picture containing air, clouds, plants, animals and a pond. This picture can be used to represent all the earth and the life on it, and can be used in developing a water cycle diagram with the students.

First discuss what clouds are and what they produce. This can be demonstrated in the classroom by heating some water and holding a cool pan or glass over the water vapor produced. Students will be able to observe water going into the air, cooling, and collecting into larger drops and falling. This activity will make it possible to introduce the terms evaporation and condensation.

Relate the water vapor to the clouds and have students indicate water vapor forms into drops and falls down by drawing arrows downward from the clouds. They can also relate the pond to the heated water and indicate the water moves upward from the pond with arrows. If the heating process causes confusion, have the students observe an open container of water on the window sill over a period of days. Where does the heat come from to evaporate the pond water? Does water need to boil in order to evaporate? Could we have clouds without evaporation?

When the water falls from the clouds, does it all run into the pond? Demonstrate this point by sprinkling water on a slanting pan of soil. Have the students observe that some water runs downhill and some enters the soil. You may illustrate this on the picture by drawing more arrows, some into the soil and some downhill along the surface.

2.5
Water Cycle
(Continued)

2.5

Do plants effect the movement of water? What happens to soil in which a plant is growing if water is not added? Demonstrate that plants remove water from the soil by first watering a potted plant, then enclose the pot only in a plastic bag. The only way water can get out is if the plant removes it. Leave the plant for several days and then examine the soil. On the picture, illustrate this water movement by drawing arrows from the soil to the plant.

Does the plant keep all the water it takes from the soil? Place a plastic bag over a potted green plant, do not include the pot, and watch for water vapor to collect inside the bag. Now use arrows to illustrate green plants pass water vapor into the air.

How are animals involved in the water movement? All animals drink. Illustrate this using arrows. What happens to the water animals drink? Illustrate some being returned to the soil as waste and some of it entering the air as sweat and air we breath out.

By now, students should be aware of the general movement of water through the earth, plants, animals, and atmosphere, and ready to consider some questions relating to the water cycle.

When water evaporates, does the "junk," mud, salt, etc., in the water go with the water to form clouds? Illustrate this by evaporating a shallow dish of either dirty or salty water and observe the residue remaining in the dish. This can lead into a discussion about how nature cleaned up the water before man caused the large amount of pollution we have today. Nature still cleans water this way, but it is not fast enough to meet our present demand for clean water.

Does water move straight up when it evaporates and then fall down in the same place? What is the source for most water that evaporates? (ocean) Winds move clouds of water from over the oceans in over the land where it falls as rain. A large part of this rainwater is moved back to the oceans by rivers.

Why do some places have more water than others? Consider the effects of wind direction and locations of mountains. Have students locate pictures illustrating areas that receive different amounts of rain. Does water evaporate faster in the polar or tropical regions? How deep can water go into the ground? Use the water cycle picture and discuss water table and impermeable rock layers. This can lead into a discussion of what a spring is. Assume the dark layer of rocks is impermeable to water so any water that soaks down to it will travel along that layer and run out the hillside forming a spring.

2.5
Water Cycle
(Continued)

2.5
How do plants use water? The water dissolves minerals from the soil so it can enter the plants, helps cool the plants through evaporation similar to our sweating and helps provide supporting structure for the plants. What does a wilty plant need?

How do animals use water? Discuss that blood is largely water and moves material within the body, helps regulate temperature, and helps remove waste from the body.

2.6
Air Cycle

2.6
One of the natural cycles difficult to understand because you cannot see it, is the "Air" or Oxygen-Carbon dioxide cycle. Students realize they breathe "air," but have difficulty thinking of it as oxygen or the air they exhale as carbon dioxide. For this reason, this activity is designed to develop: 1) an awareness that animals use something from the air; 2) plants use something from the air; 3) that plants release into the air the substance animals use; 4) that animals release into the air the substance plants use; and 5) plants and animals are both needed in order that either can live.

A series of diagrams illustrating the oxygen-carbon dioxide relationship are provided in Appendix C for use in developing this interrelationship between plants and animals. Do not start the discussion using the words oxygen and carbon dioxide, as they will only add confusion and both terms will be more meaningful if introduced after their role has been developed.

Before having the students work with the diagrams, use these or similar questions to start students thinking about the use and role of air by plants and animals. Why do we breathe? Do we use all the air we breathe? Is the air we breathe out different than that we breathe in? Do plants need to breathe? What happens when we are in a closed room? Why does fresh air smell so good? What happens to air inside our body?

As you prepare to use the oxygen-carbon dioxide relationship diagrams explain to students they are going to look at pictures showing what happens in an experiment performed by a scientist. Special Note: Do not try to repeat this experiment as it is very difficult to control all variables. Students will do a better job of interpreting the illustration if they receive only one series at a time. This can be done by cutting the page before distributing them to the students.

After distributing the first series, explain that the scientist placed a live mouse, food, and water in the large jar and then sealed the jar with only the items and air. Nothing can enter or leave the jar until it is again opened. By the end of 48 hours, what happens to

2.6
Air Cycle
(Continued)

2.6
the mouse? (dead) Why did the mouse not die the first day? Explain that there was plenty of food and water for the mouse and things like temperature were carefully controlled. Lead the students into a conclusion around the idea that the mouse needed something that it used up from inside the jar.

Now distribute the second series and go through a similar discussion regarding the plant as you did for the mouse. A similar type conclusion should be drawn.

Before distributing the third series ask the class what they think would happen if the mouse and plant were in the same jar. The divider in the jar prevents the mouse from eating the plant but allows air to move from one side to the other. After the students observe the third series, they should conclude that the plants and mouse must provide whatever the other needs as neither the plant nor mouse dies when they are in the same container.

Now you can introduce the term oxygen and carbon dioxide. Explain that we call the stuff given off by the plant and needed by the animal, oxygen, and that we call the stuff given off by the animal and needed by the plant carbon dioxide.

Explain that this experiment is just like a little world. The air in the jar could be compared to our atmosphere, the mouse represents all animals, and the plant represents all green plants. Before going to the fourth series illustrate the oxygen-carbon dioxide cycle on the board showing plants giving off oxygen and requiring carbon dioxide and the animals giving off carbon dioxide and requiring oxygen. Ask what would happen if all green plants were removed from the earth. What if all animals were removed?

The fourth series is certainly optional, but can be used to illustrate that burning substances produce and use the same gasses as animals. This can be used to lead into a discussion of how our bodies used the oxygen to burn our food to release the energy it contains.

As a final activity, you might discuss why the scientist kept all the conditions and equipment the same except those conditions he was experimenting with. For example, why should the food and water dish be in all containers? Why should the divider be in all containers? This will allow you to bring out the importance of carefully controlling all conditions and keeping the conditions the same during an experiment.

2.7
Plant Life Cycle

2.7
The cycles thus far discussed either dealt with the nonliving or interaction of living and nonliving. There are also cycles within the living organisms, such as plant and animal

2.7
Plant Life Cycle
(Continued)

2.7

life cycles. By the end of this and the next activity, students should be aware that 1) plants and animals produce offspring like themselves; 2) more offspring are produced than will survive on the earth; and 3) reproduction is nature's way of insuring that a certain kind of plant or animal will be present when the adults die.

Plant life cycles are relatively easy to demonstrate in the classroom using either peas or beans. With an adequate light supply and reasonable care, beans or peas will complete a life cycle in about six weeks. See Appendix C for more detailed instructions. If you do not wish to make this into a long-range activity by growing a plant completely through a life cycle, a picture series illustrating the various stages of a typical plant life cycle is included in Appendix C.

Hopefully, the students will realize seeds are "living" from their earlier work with living and nonliving things. If they don't, this activity should help clear up misunderstandings.

Start a class discussion by showing some seeds and ask what will happen to the seeds if they are placed in moistened soil. Discuss what kind of plant the seed might grow to be. Can one kind of seed grow into more than one kind of plant? How long will it take the seeds to grow (sprout)? Will all the seeds grow?

After students have seen the seeds start growing is a good time to introduce the words sprout and germinate.

Once the students have viewed a complete life cycle, either in pictures or through growing plants in the classroom, many opportunities are available to increase their awareness of plants and plant variation in their surroundings. Direct their thinking through questions similar to the following. Do all plants produce seeds during the same season? Do all plants die after producing seeds? What are some examples of ways flowers vary in shape and color? Do trees produce flowers and seeds? When do most plants produce seeds? Do all plants produce flowers? Do all seeds a plant produces grow? Do all plants produce seeds every year? Does man depend on any plant seeds for food? What are some examples of seeds we eat? Do we eat strawberry seeds? Do animals help plants spread their seeds? How? Are seeds the only way plants reproduce? Does your mother raise new flowers from cuttings. What are some ways seeds travel to new locations? Why are bees and butterflies found on some flowers? What does a flower contain that is important? Which comes first, the green plant or seeds? Do all seeds have a fruit around them? How do animals use plants besides eating their seeds? How are some plants different from most?

2.7
Plant Life Cycle
(Continued)

2.7
Students could follow this discussion by each developing plant life cycle diagrams using pictures (collect old seed catalogs). Seeds can be collected from wild plants on their way to school or from local parks and planted. It is interesting to see how they develop.

2.8
Animal Life Cycles

2.8
Some organisms live only short periods of time while others live many years. Animals, birds, mammals, insects, fish, etc., have a great variety of ways to reproduce their own species and the growth patterns from birth or hatching to adult is just as varied as are different species. As with plant life cycles, the important thing for students to grasp is not the particular life cycle pattern of a given animal. It is important to understand the common process of adults of any species to reproduce their own kind and animals depend on factors of their environment in order to produce and raise new offspring.

For those teachers wishing to have their students observe some animal life cycles in the class room, animals like fruit flies, guppies, gerbils, frogs (order frog eggs), and mealworms are rather easily maintained and require relative short time spands. Directions for maintaining each of these animals in the classroom is included in Appendix C.

As you are discussing animal life cycles, be sure to include some involving eggs (birds, some reptiles, fish), some involving live birth (mammals), and some involving changing forms or stages (insects).

For those wishing to use them, some animal life cycle illustrations are included in Appendix C.

Animal life cycles discussion topics:
  Do large animals tend to have more or less offspring than small animals? (cow compared to fly)
  Does the amount of care mothers provide for the young vary with the number of offspring?
  Do all animals produce offspring that look like themselves?
  Do any adults die after the eggs or young are produced? (salmon and mayfly)
  Is man an animal?
  What kind of animals give the most care to their young?
  What are some examples of how animals care for their young?
  Do the young eat the same food as their parents?
  What would the world be like if all offspring lived?
  What would happen if adults did not produce offspring?

2.8
Animal Life Cycles
(Continued)

2.8

Do animals that live many years produce more or less offspring than animals that live only a short time?

What are some examples of ways animals depend on nature to help produce young? (frogs must have water for their eggs, some insects lay their eggs in other animals, turtles depend on the sun's warmth to hatch the eggs, available shelter, etc.)

How long does it take for the young to be independent of the parents?

What special requirement do the young have?

Do the young live in the same place as the adults?

How has knowing animal life cycles helped man? (disease control)

A good closing for the discussion of animal life cycles would be to have students individually or in small groups research a given animal's life cycle, make diagrams illustrating it, and record any special requirements or interesting facts. Examples of animals' life cycles that students would find interesting are: malaria, turtle, rattlesnake, frog, salmon, raccoon, housefly, kangaroo, oppossum, rabbit, crayfish, redbird, bee, ant, grasshopper, quail, tapeworm, termites, silkworm, snail, mosquito, horse, crocodile, pelican, woodduck, bobcat, and black bear.

2.9
Food Web

2.9

As illustrated by the various natural cycles, no single organism or part of the environment exists entirely by itself. This idea can be further illustrated by a food web, a diagram showing what eats what within a group of organisms. Due to the complexity of food webs, it is often useful to discuss individual food paths within the food web. These are known as food chains. Natural food webs and food chains are extremely complex and interwoven, but the concept of food webs and food chains can be illustrated with simplified diagrams. Food webs can be specific for a small area, like a pond, or more generalized to represent larger areas like continents. A food web illustration should include the three basic groups of living organisms found in any area; producers, consumers, and decomposers. Producers are the green plants and are responsible for producing the food for all living organisms. The consumers are all other living organisms that depend on the producers for their food. The decomposers are responsible for decaying the plants and animals when they die. Develop these terms and roles with students only after they have worked with some food web illustrations.

Students find it enjoyable to role play and role playing is a good way to introduce food webs to students. Each student is to assume he is some plant or animal during the exercise. It is helpful if the students are assigned the plant or animal role they will be

2.9
Food Web
(Continued)

2.9

playing a few days before doing the activity so they can research what it eats or is eaten by. A name sign with each plant or animal being involved and a ball of yarn are the only materials needed. Some examples of plants and animals to use in the role playing are: grass, corn, oak tree, cedar tree, weed, algae, clover, cattail, mouse, rat, fly, flea, coyote, oppossum, rabbit, fox, deer, raccoon, fish, snail, water bug, microscopic plants, earthworm, beetle, spider, bacteria, toadstool, mold, microscopic animals, hawk, lizard, mole, snake, grasshopper, tick, vulture, gooseberry, wildflowers, and bee.

To develop the food web in the classroom have the students arrange their desks in a circle. Place their organism label where all others can see it. Start by asking one of the organisms what eats it or it eats. Once they have indicated which organism they eat or are eaten by connect a piece of yarn or string between them. Continue this until all students have at least one string connected to them. Taping the string to their desk works better than having them hold it.

While the students are still seated in a circle and have the "web" conduct a short discussion centered around the following questions.

Which of the organisms were eaten but did not eat other organisms? (producers - the green plants) This can be followed up with the introduction of the term producer.
Which of the organisms got their food from dead plants and animals? Decomposers - bacteria, mold, toadstool, earthworm. Introduce the term decomposer.
Which of the organisms had to eat plants or animals to get their food? Introduce the term consumer.
What is food?
Could anything live if there were no green plants?
Trace one of the food chains within your food web. For example: grass (producer) is eaten by the rabbit (consumer) is eaten by the coyote (consumer) dies and is decayed by the bacteria (decomposer).
What does a green plant do that animals cannot do?
What effect does the coyotes eating the rabbits have on the number of rabbits?
Why is bacteria important?
What are some factors that affect the number of any one group other than being eaten?
What will happen to the rabbit population if man kills all the coyotes?
When food spoils, is this part of a natural cycle?
What type of organism causes spoiling?
What are some ways of slowing or stopping food spoilage?
Is it bad that one animal eats another one?

2.9
Food Web
(Continued)

2.9
Can you illustrate some food chains man has tried to develop for his own use?
How does man's knowing animal food chains and food webs help him?

In summary, review with the students that 1) green plants must have sunlight, water, and carbon dioxide available in order to make food; 2) only green plants are capable of making food; 3) food is matter and energy; 4) all animals either directly or indirectly depend on green plants for food; 5) animals get their energy and matter for their bodies from the food they eat; and 6) no plant or animal can live alone.

For additional practice with food webs, some illustrations are provided in Appendix C in which the students can connect organisms illustrating what eats what in each group. The class can discuss the role of the individual organisms within the food web and follow the food chains.

2.10
Matter Cycle

2.10
What happens when items are sold from a store and not replaced? The earth is like a big store, plants and animals are constantly removing water, minerals, etc., from the earth and if they were not being replaced, the earth's substance would soon be depleted. A simple classroom illustration of this could be to have a box of penny candy and have each student take one until they are all gone.

To examine more closely how minerals move within the environment we will establish a matter cycle similar to the other cycles thus far discussed. By the end of this activity students should be able to explain: 1) matter moves from soil into plants, 2) matter moves from plants to either animals or back into the soil when the plant dies, 3) matter of animals is returned to the soil when the animals die and 4) matter is reused.

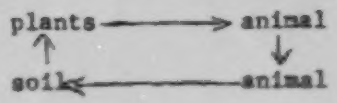
Open a class discussion with some questions such as: Why do we eat food? Where do we get our vitamins and minerals? Where do we get the material used to build our bodies? Where do plants get their minerals and body building substance? What happens to plants or animals when they die?

Using the students answers, start a diagram on the board illustrating the sources of man's minerals or matter. This should include some plants as well as some animals. Ask where the animals we eat get their minerals or matter. This should trace back to all animals getting their minerals from some plants. Indicate plants get their minerals from the soil.

2.10
Matter Cycle
(Continued)

2.10
Next bring up the question of what happens to the matter in the bodies of plants and animals when they die. Lead the discussion to where students realize that when things die, the matter in their bodies is broken up (decayed) by things like bacteria and returned to the soil for reuse.

Your simple matter cycle might look like this:



Many far more complex matter cycles such as carbon cycle, nitrogen cycle, calcium cycle and others are found in reference books, but are more complex and detailed than needed for the purpose intended here.

Close your discussion of the matter cycle with these ideas: What would the world look like if no plants or animals decayed when they died? Why are green plants important? Could your body be composed of some of the same matter as some ancient dinosaur had in his body? What would the world be like if we continue to make a lot of things from plastic? It does not decay! Does any plant or animal live forever? Is it true that some must die so others may live?

2.11
Earth Cycle Wall Poster

2.11
Each school has a copy of the poster.

The Earth Cycle Wall Poster (PG 456) published by Scholastic magazine illustrates a series of natural cycles and can be used in reviewing the water cycle, carbon dioxide-oxygen cycle, nutrient cycle, and food web. All are excellent illustrations. The only problem you might run into while using them is the title, The Energy Cycle (Food Chains), which the poster uses in place of food web.

2.12
Review Matter Cycle
Using Films

2.12
Once students have been exposed to various cycles and relationships existing in the environment, they are ready to see how the various processes work together.

By using the guide questions suggested in Appendix A for the films "Life of a Plant" and "Sunlight," students will be able to see how the various processes interrelate.

2.13 Variation and Similarity

2.13
Quite often all of us tend to overlook the great variety that exists in nature. Fish are fish, grass is grass, and trees are trees! We do not take the time to realize the variety that exists within the fish, grass, or tree groups. By directing our attention toward the variety of living organisms, we not only become better observers and appreciate nature more, but also tend to increase our descriptive vocabulary. The following activities are intended to increase student awareness of variation and similarities between organisms.

The variation and similarity pictures game in Appendix C is to be used during this exercise and can be done in either small groups or as a class.

Each student involved will need a copy of the picture page being used. The leader of the group selects one of the organisms on his page and circles it so he will not forget which one he selected. The other group members will be allowed to ask only yes and no questions about the pictures until one of them can figure out which organism the leader selected. The leader responds only with a yes or no. Once a group member thinks he knows the right answer, he raises his hand and asks to give his answer. If he is right he gets five points, if he is wrong, he loses five points. Group members take turns asking questions. Group members are directed to look for ways the organisms differ and ask their questions so they can eliminate some. They cannot ask questions about organisms names or numbers, but only about their descriptions.

Some of the organism picture groups are much more difficult to work with than others. It is suggested you do one of the easier ones in class to demonstrate procedure and rules.

Rewards for highest points can be determined by the teacher.

Doing this type of enjoyable game should increase their awareness of variation and similarity of organisms, and increase their usage of descriptive adjectives.

The films "Mammals are Interesting" and "Putting Animals Into Groups" can be used to help students understand some of the ways animals are varied, but still have many characteristics in common. Helpful summaries and guide questions for both films are available in Appendix A.

2.14 Introduction and Discussion of Succession (change)

2.14
In day to day living, students as well as adults do not notice the slow but constant changes occurring in our environment. The term used by ecologists to describe the changes occurring in the environment is succession. Succession can be either entirely natural or man can cause a change in the rate and direction of changes. In order to have a comprehensive idea

2.14
Introduction and
Discussion of
Succession (change)
(Continued)

2.14
of their environment, students need to be aware of the changes that are occurring and some of the general patterns of the changes.

To start students thinking about environmental changes, ask them what is different in their community now compared to three years ago? Have more people moved into the community? Have more houses been developed? Have the streets developed more cracks and holes? How have the play grounds changed?

Once they are able to see changes in the area around their school, then changes in more distant areas can be discussed. How has the city changed? Has it increased in size or number of people? What evidence supports their answer? Are people building houses where there used to be farm fields or woodlands? Are old houses being abandoned and an old block growing into weed patches? Have some old houses been removed to make room for new houses or other types of buildings?

Compared to the stories you have read, how does your state appear now with what it was like one hundred years ago? Has the population changed? How did most of the people make a living then compared to now? What kind of food did the people eat then? What kind of transportation did the people use then? What kind of homes did more people live in?

Most of the changes thus far discussed have been either in man's life style or brought about by man. Does nature change without man's actions? Does an area with woods or another area with grass or a lake just suddenly happen to be the way it is now?

2.15
Succession on Land

2.15
Conduct a class discussion about some hypothetical area where all plants and animals have been removed. This could be a vacant lot, the school yard or in the center of some National Forest. Explain that they are going to be mother nature and place plants and animals in the area over a period of time.

Start by asking which should be put in first, green plants or some animals? Bring up the need for food producers. Which kind of plants should be first, large ones or small ones, tender ones or tough ones? Which will better be able to survive? Take a short trip around the school and look for places like in pathways, for example, of tough plants that can withstand bright sunlight and strong winds. Would it be any advantage for the plants to have stickers or thorns? Think about desert plants. Nature tries to keep some plant cover over the soil to protect it. Which kind of plant usually covers a bare area first?

2.15
Succession on Land
(Continued)

2.15
Once these first plants are present to provide food, animals will move into the area. Will the first animals be large ones or small ones like insects? Other plants that need a small amount of shade in order to get started will now move into the area. How did their seeds get into the area? As the second group of plants take hold, they will become the dominant group for a while and animals that use them for food and shelter will move in. These plants could likely be thick, rather tall weeds and the animals could be ground birds, rats, mice, and other ground creatures.

The second stage could likely take over by fast growing small trees and shrubs. Along with the trees would be song birds and other tree oriented animals.

After many years, the first tree growth would give way to the larger more permanent trees and plants that could tolerate shade would grow on the forest floor.

Although this is a hypothetical illustration, many similar situations have occurred and are in the process of occurring.

After going through this illustration ask some questions such as: How can you tell if a forest area is a new one or an old one? (presence of old decaying trees) What happens to the first plants to live in the area that needed lots of sunlight? Why did the types of animals change as plant types changed? Does the type of plants present change the local environment? Does nature usually have a large variety of plant types present in an area or mostly one kind? What happens to your yard if you don't keep it mowed? What do we find happening where man puts in fences and does not mow under them? What about the fence around the school yard? How do the plants next to the school building differ from those in the open school yard?

2.16
Succession in a Pond

2.16
Ponds, lakes, and oceans also undergo succession similar to that found on land. The diagram illustrating pond succession (Appendix C) can be used to help discuss the changes that occur in any body of water.

Emphasize that minerals and material from the surrounding land is constantly washing into the water, filling the pond or lake. The minerals also allow more plants to grow in the water. The more plants present, the more animals that can live in the water. This process continues until the body of water is filled with material from the decaying plants, animals, and surrounding land. Eventually, the lake or pond is a level field. The large peat deposits were formed in this matter. It is also believed much of our coal deposits resulted from

2.16
Succession in a Pond
(Continued)

2.16
similar processes.

Man has caused succession in our lakes, ponds and rivers to be much faster as a result of adding waste such as sewage and chemicals (pollution).

2.17
Establish a Classroom
Terrarium

2.17
A simple and enjoyable way for students to observe succession is by establishing a gallon jar terrarium and keeping it in the classroom. Directions for constructing a terrarium are in Appendix C. Once the terrarium is started, do not bother it. Allow the organisms to make their own adjustments to their environment. If it appears to die, observe it closely to see how it will recover on its own. The new growth could be entirely different from the original.

In concluding your discussion about succession, emphasize that the environment is constantly changing, never staying the same from day to day. The plants and animals are constantly competing for the earth's space and material. Those best suited for a particular condition will remain in the area.

2.18
Adaptation of Organisms

2.18
Why do we find moss only in shaded and moist areas? Why are polar bears only found in cold regions? Why do most wildlife produce their young during the spring? Why can gerbils live in a desert with very little water? Why don't trees grow on top of high mountains?

Questions of this type will stimulate thinking about how plants and animals are specialized (adapted) to live in only certain conditions and ways. If the conditions that a plant or animal requires are not present, then the organism will die. Why is it so hard to raise some animals or pets? What caused so many animals to become extinct?

When the settlers plowed prairies of middle U. S., he destroyed the nesting grounds of many birds like the prairie chicken. The number of deer in Kansas is increasing because man's activities have increased the amount of shrubs available which is an important food for deer.

Many plants and animals have structural adaptation like specialized feet, beaks, leaves, etc., that allow them to better survive in a given area than others that might compete with them for food, space, and shelter. What adaptations do animals have that live in polar regions? Do plants near the north pole have a long or short growing season? Do animals living in grassland have long or short legs? How do some animals living in wooded areas differ from

2.18
Adaptation of Organisms
(Continued)

2.18
those living in a grassland? Do animals with sharp cutting teeth tend to eat plants or other animals? (grazing animals) How are teeth of coyotes and lions alike? How does the type of teeth they have help them? (capturing and tearing up live animals)

2.19
Using Plant and Animal
Adaptation Pictures

2.19
Use the plant and animal adaptation pictures and the attached explanation (Appendix C) to relate structural features with a type of habitat and method of living. Following the discussion of the illustrations showing plant and animal adaptations, ask the students if they can think of other ways plants or animals are specially adapted to live in a certain place or way.

End the discussion about adaptation with the idea that plants and animals live where they do because they are best fitted to live in that place and in that manner. If we destroy the place an animal or plant lives, we will probably also destroy the organism.

2.20
Man and His Environment

2.20
Once students have developed a general understanding of how the various parts of his environment function together as one large system he should be interested and concerned with how man's activities fit into and affect the various parts of the environmental system.

A short class discussion about, "What is man?" would let the teacher find out how the students view man in comparison to the other living organisms. Questions such as the following could be used to guide the discussion.

What are some of the basic needs of man in order for him to live? (food, water, oxygen, etc., the same as other animals) Does man have any special adaptations that help him live the way he does? (consider his thinking ability) Does he get his food by being faster than other animals? How does his home differ from homes of other animals? What makes man different than other living organisms? Do other plants and animals have the ability to change the environment as much as man? Why?

This series of activities will direct the student thinking toward some of the ways man uses the substances in his environment and the effects those uses have on the environmental systems. These activities can be either grouped together or conducted as individual activities and conducted when convenient.

2.20
Man and His Environment
(Continued)

2.20
Have the students examine substances they are using in their daily life habits and then trace the substance back to its origin. For example, what objects are they using in school today? Students could name: pencils, paper, clothing, electricity, ink, etc. Select one like paper and ask lead questions such as: How is paper made? What is used in making paper? Where is most paper made? Even with the limited knowledge students will associate trees with paper. Once they associate trees with paper then you can delve into the many ways we use substances obtained from trees. Helpful wall charts are included in Appendix G.

2.21
Man and His Environment
Display

2.21
To lend organization and structure to this discussion, individual students, small groups, or the entire class can use the bulletin board to develop a "Man and His Environment" display. The "Man and His Environment" display would consist of a series of concentric circles with man in the middle. The first layer outward would contain items (pictures or words) that man uses directly. The second layer would contain substance needed to produce the items in the first layer and this pattern could be continued outward as far as needed. A simple form is illustrated in Appendix C. The "Man and His Environment" display will help students realize the many ways they use environmental substances indirectly. The following questions may help develop ideas for the displays.

Where did the food we ate today come from? A similar question can open up a great variety of avenues for class discussion. To give the class some direction, you might suggest they first decide if the food was plant, animal, or a mixture of both. Can this information be used to develop food chains? Determine which food items were grown locally and which required considerable transportation. At this point, emphasize how large the environment is. If the food had to be stored for long periods of time or transported great distances, what did they do to it to keep it from spoiling? How does this relate to the matter cycle? Can the foods be grouped into highly processed foods and "natural" foods? Which type of food, highly processed or "natural," involves the more complex food web?

What is our clothing materials made from? How many of our present day materials for shoes and cloth are from plants and animals? Can the students construct cycle diagrams illustrating the pathways involving such materials as wool, cotton, plastic, leather, nylon, dacron, etc. Diagrams for such things as wool could involve the sheep food chain as well as the manufacturing process and end the cycle with the material being decayed. Any one or all of these could be used to better illustrate to students the various ways they depend on and use environmental substance.

TOPIC III: Rivers and Reservoirs

3.0
Introduction

3.0
This study of water will concentrate on how man uses bodies of water and the water movement patterns on the earth surface. Special emphasis will be placed on local rivers and reservoirs.

Of all the substances in our environment, water is one of the most important. Water is needed by all living organisms, it helps regulate our climates, and moves substances over the earth's surface. Water is a friend of man, yet it can cause suffering and loss.

Before starting this topic, be sure the students have worked with the water cycle activity in the Plant and Animal topic. After reviewing the water cycle, explain to the students that they are going to study in more detail that portion of the water cycle where water moves over the land surface. This more detailed study can be introduced with such general questions as: 1) where do most cities in Kansas get their water supply? 2) does only water that falls on Kansas flow in Kansas rivers? 3) where does the water in Kansas rivers go? 4) toward what direction do most Kansas rivers flow? 5) how have river locations affected the location of cities? 6) how were the early settlers affected by rivers? 7) how do rivers affect our lives? and 8) does water move uphill or downhill?

These questions will create an interest that can be used to introduce the study of river patterns in Kansas.

3.1
Kansas River Map

3.1
The Kansas River map can be used to introduce the basic concepts relating to rivers. Later students will combine the information developed by using this map and other maps to develop a rather comprehensive knowledge about river patterns and their affect on people's lives.

From this first map activity, students should obtain the following concepts: 1) Rivers flow from high elevations to lower elevations. 2) The Kansas River drains the north half of Kansas. 3) The general flow of water in Kansas is from northwest to southeast. 4) Small creeks and rivers join to make larger rivers. 5) A watershed.

Each student should have a copy of the Kansas River map (Appendix D) for his own use to mark on as suggested or desired. If the students have had little map work, start by determining and labeling the four directions, then discuss the following questions:
How can you tell which end of a river is the beginning or upstream of a river?
Which directions do most of the rivers in Kansas flow?

3.1
Kansas River Map
(Continued)

3.1
Do the rivers in the north half of Kansas flow the same direction as the rivers in the south half of Kansas? How can we tell?

Locate the beginning of the North Fork of the Solomon River in Thomas County (1)*. As you follow the path of water from this point, name the rivers it flows into. Where does this second river end?

Where does the Kansas River start?

What river collects most of the water in the north half of Kansas?

Which side of Kansas is higher, the east or west? How can you tell?

Can the students guess any reasons for giving particular names to some of the rivers?

Toward what direction does the land in the Northwest corner of Kansas slope?

Toward what direction does the land in the southern counties slope?

Does the Arkansas River start in Kansas?

Which river forms part of the border of Kansas?

Can you tell which parts of Kansas get the most rainfall by the number of rivers present?

Which of the following in each pair of counties is higher in elevation?

Thomas (1) - Phillips (2)
Shawnee (3) - Dickinson (4)
Labette (5) - Morris (6)
Hamilton (7) - Ford (3)
Montgomery (9) - Greenwood (10)
Barton (11) - Cowley (12)
Shawnee (3) - Wallace (13)

What happens to the water in most of the creeks and rivers?

What happens to the Whitewoman Creek in Scott County (14)? Can you find any other creeks that do the same thing?

What helps you guess which areas drain into any given river? Draw a circle around the area that you think drains into the Delaware River. Do the same for the Republican, the Solomon, and the Smoky Hill Rivers. After students have determined the general area draining into the rivers, introduce the term watershed. The watershed of any river is the area that drains into it. Can the watershed of any river be included in the watershed of another river? Illustrate this by having the students circle all the area that drains into the Kansas River. Could the Saline River watershed and the Delaware River watershed include the same area?

(*Numbers denote county location on the Kansas River Map.)

3.2
Missouri River
Watershed

3.2
After determining the watersheds of some of the rivers in Kansas, students will be interested in still larger watershed patterns. The Kansas River drains into the Missouri River. By having the students view copies of the Missouri River watershed (Appendix D) maybe they

3.2
Missouri River
Watershed (Continued)

3.2
can answer these questions:
What area, other than Kansas, drains into the Missouri River?
Where does the Missouri River start?
How many states drain water into the Missouri River?
How much of Kansas is included in the Missouri River watershed?
What river does the Missouri empty into?
Could pollution in the Yellowstone River in Montana affect the water in Kansas City?
What is on the west side of the Missouri River watershed?
What do we know about the elevation of Montana compared to Nebraska?
Is the Missouri River watershed included in the Mississippi River watershed?
Could pollution in the river water at Topeka affect water in the Mississippi River?

3.3
Use of the Kansas
Highway Map

3.3
The purpose of this map activity is to locate some of the larger cities and reservoirs within the state and relate their location to the rivers. You may wish to do a more extensive study of the highway map as it is an instrument students will be using throughout their lives.

The greatest problem students have in using a highway map is being able to isolate a specific area. Before trying to translate city and reservoir locations from the state highway map to the river map, spend some time learning to read the highway map. Start by explaining the purpose and use of the index guides. You might have students locate "E" on the left side of the map and "2" on either the top or bottom. If the students draw a light line across from the "E" and up from the "2" until they intersect, they will be able to locate the city of Syracuse. Point out that the index guides do not always give an exact location, but give the area in which to look. Practice locating some other towns and cities such as the following: Great Bend (D-6), Manhattan (C-10), Independence (F-11), and Pittsburg (F-12).

What marking or symbols are used on the map for each of the following? Highways, Interstate, Rivers, Lakes, and Reservoirs, County Boundaries, Airports, and the Parks.

Locate St. Francis (B-2) and note the elevation (3292). What does this elevation number indicate? Discuss that elevation measurements represent the number of feet above sea level. By recording some of the elevations throughout Kansas on the Kansas River Map, students will better be able to understand why the rivers flow the direction they do. Some other areas from which to transfer elevations from the highway map to the river map could be: Ulysses (F-2), Great Bend (D-6), St. John (E-6), Winfield (F-9), Hiawatha (B-11),

3.3
Use of the Kansas
Highway Map
(Continued)

3.3
Topeka (C-11), and Independence (F-11).

Relate these changes in elevation with the direction that the rivers flow. Why does the Arkansas River make the large curve in the middle of the state? How did the city of Great Bend get its name?

Have the students locate the following cities on the highway map and then mark their approximate location on the river map. Great Bend (D-6), Goodland (B-2), Garden City (E-3), Manhattan (C-10), Topeka (C-11), Kansas City (C-12), Wichita (F-9), Arkansas City (G-9), Independence (F-11), and Parsons (F-12). Which of these cities are located along rivers? What are some reasons cities have developed along river banks? What other factors now days affect city location and development?

3.4
Reservoirs

3.4
When Kansas was first settled very few natural lakes existed. Most creeks and rivers flowed more evenly than they do today. The natural cover of grass and other plants held the water and allowed it to run into the streams at a slower rate. As man plowed the land, removed plants, covered the land with roads and concrete, he caused the water to run into the stream much faster. Floods resulted from this more rapid run off of water. Use a transparency of the Raindrop Splash diagram (Appendix D) to illustrate the effect of plant cover.

Around the middle 1900's, people became concerned about the damage caused by floods and started building various types of dams to control the flow of water. The dams are built to collect water during heavy rains and release it slowly between rains. The dams range in size from small farm ponds to large reservoirs. What are some other benefits man gains from ponds and reservoirs? (recreation, water storage, and wildlife conservation)

3.5
Perry Reservoir

3.5
A closer look at Perry Reservoir will illustrate how man made lakes are used and the effect they have on an area. Due to extensive flooding along the Kansas River (Manhattan, Topeka, and Lawrence) during the early 1950's the Congress authorized the building of Perry Reservoir in 1954. Construction started in 1963 under the direction of the Corps of Engineers and was completed in 1969. Have the students list the ways Perry Reservoir is useful. The list should include flood control, various types of recreation, and wildlife conservation and water conservation.

How has the presence of the lake affected the reservoir area?

3.5
Perry Reservoir
(Continued)

3.5
What was the area used for before Perry Reservoir was built? Most of the area was in small farms. What happened to the farmers? What new businesses have developed as a result of the reservoir? How will building around the lake affect the area? How has the reservoir affected the town of Perry?

3.6
Lakes and Reservoirs in Kansas

3.6
Using the highway map, locate the river on which each of the following lakes or reservoirs is built and mark its location on the river map. Cedar Bluff Reservoir (D-5), Webster Lake (B-5), Kirwin Reservoir (B-6), Glen Elder (B-2), Cheyenne Bottom (D-2), Cheney Reservoir (E-8), Milford Reservoir (C-9), Tuttle Creek Reservoir (B-9), Perry Reservoir (C-11), Pomona Reservoir (D-11), John Redmond (E-11), and others.

Which part of the state has the most lakes or reservoirs? Which lake is not man made? (Cheyenne Bottoms) Which reservoirs help prevent flooding in the Topeka area?

How do they measure the amount of water in a lake? Not in gallons, barrels, or quarts, but in acre-feet. One acre-foot would be water one foot deep covering one acre which is equal to 325,851 gallons, Perry Reservoir normally holds around 150,000 acre-feet of water. How many gallons is that?

3.7
Water Safety

3.7
By the end of this activity, students should be aware of some of the water safety rules. To share their awareness of the water safety rules with other students in the school, have students make cartoon posters illustrating safety rules and place them in the school hallways. With the increased number of large bodies of water and additional leisure time, people are becoming involved in water related recreation. As a result, there has been an increase in drownings from swimming and boating activities.

A short discussion about water safety can be initiated with questions such as: How many of you have been in a boat? Follow this by the question, did you wear a life jacket while on the water? Did you wear a life jacket if you were skiing? Why does the state have a law requiring boats to have a life jacket for each passenger? Explain that most people get scared when a boat has an accident or turns over and a good life jacket can keep their head above the water until help can arrive.

What are some safety problems people have while boating? How many people can ride in one boat? Does the boat size make any difference? Can all boats stay afloat during rough waves during storms? What should small boats do as a storm is developing? Should people stand up in boats?

3.7 Water Safety (Continued)	3.7 Are there areas where a boat should not go? (swimming and restricted areas) Should people just swim anyplace they wish in a reservoir? Why do they set aside special areas for swimming? Explain that many things such as deep holes, wire, and brush that cannot be seen often are around reservoir shorelines and can cause accidents. What are other safety problems that cause drowning in reservoirs? 1) Poor swimmers getting too far from the shore. 2) Non-swimmers wading in unsafe water. 3) Swimming alone. The students should be aware of these water safety rules: 1) Always wear a life jacket when in a boat. 2) Do not over load a boat. 3) Do not get in a boat being handled by a person who is drinking. 4) Never stand up in a boat. 5) Do not go boating or swimming during a storm. 6) Swim only in designated areas. 7) Never swim by yourself. 8) Do not exceed your swimming ability. 9) Wade only in designated areas. 10) Learn to read and obey posted safety rules for boats and swimmers. Place the following Corps of Engineer safety posters (Appendix D) on the bulletin board for student viewing: If You Insist on Drowning, Reservoir Navigation Aids and Markers System, Drownings in MRD Reservoirs.
3.8 View the film "Birth of a River"	3.8 This film reviews the role, formation, and terminology of rivers. See the film summary and discussion questions in Appendix A.

TOPIC IV: Archery

4.0
Introduction

4.0
With our present day trends toward earlier retirement, shorter work week, and desire for outdoor recreation, students need to be aware of non-destructive, but enjoyable ways they can spend their leisure time. Archery, when properly practiced, is one answer to this need.

While studying this topic, the students will learn: 1) the basic safety rules of archery, 2) the basic procedures required in handling and using archery equipment, 3) some of the history of archery, 4) the basic terminology used in archery, 5) the method of scoring archery, and 6) some of the social values of archery.

4.1
Archery Equipment
(bow and arrow)

4.1
Before starting your discussion of archery, contact Mr. Kellogg and obtain a bow and arrow to have in your classroom for student viewing during discussion. Also available in Appendix E is a bow and arrow diagram from which you can make a transparency or student copies for use during discussion. It is suggested you start the archery discussion with the equipment, as it will create the greatest student interest. Point out that during the field trip, all students will have an opportunity to use a bow and arrow. Before the field trip, they need to understand the safe ways to handle and use the equipment.

As the students are viewing the arrow or arrow diagram, locate and name the following parts and explain what each does:

Nock: The deep groove in the end of an arrow into which the bowstring is fitted.
Fletching: The feathers on an arrow which help guide the arrow during flight.
Shaft: The middle section of the arrow which provides the length needed to keep the arrow going straight.
Target point: The sharp forward end of the arrow that enters the target.
Quiver: A device for holding the arrows.

As the students view the bow or bow diagram, locate and name each of the following parts and explain its function:

Handle: The area designed for pushing against during shooting.
Nocks: Notches on the ends of the limbs into which the bowstring is attached.

4.2
Safety Rules

4.2
Point out to the students that any equipment, whether a gun, a fishing pole, or bow and arrow, can be dangerous, if the people using it are careless. Have the students list what they think are good archery safety rules. Be sure they include at least the following:

4.2
Safety Rules
(Continued)

4.2
1) While shooting with a group, shoot only when told; 2) Make sure the archery range is clear before shooting; 3) Retrieve arrows only when given the command to do so; 4) Shoot only into areas that you can clearly see; 5) Never shoot straight up; 6) Shoot only at objects that the arrow will not ricochet from; 7) Never use a person as a target; 8) Place an arrow in shooting position only when you are told you can shoot; 9) If you drop an arrow, leave it until the group is told to retrieve arrows; 10) Be considerate of others; 11) Always aim an arrow before releasing it.

Students can draw posters illustrating good and poor archery safety rules. An example is provided in Appendix E.

4.3
Target Shooting
Technique

4.3
In any sport there is a correct and an incorrect way to use the equipment. By learning and following the correct technique for handling and using the archery equipment, students will not only perform better, but will also gain more enjoyment from archery.

The directions provided are designed for groups, but most are still true if an individual is by himself. 1) Location. Stand behind the shooting line in preparation for shooting. 2) Stance. Right-handed archers should stand with their left side toward the target. Feet should be shoulder width apart, and the body weight should be distributed evenly. Stand with the body erect and relaxed. 3) Nocking. After all people are behind the shooting line, the leader will give the signal to nock your arrow. You do this by placing the nock of the arrow over the middle area of the bowstring. Grasp the bowstring with the first three fingers with the arrow between the index and second finger. The forward end of the arrow should be on the arrow rest just above the handle. The second hand should be placed on the handle. Do not grip the handle, but push outward slightly until ready to shoot. The archer should hold the bow parallel to the ground and next to his hip until given the command to shoot. 4) Drawing. Draw the arrow only when the leader gives the command to draw. Draw the arrow by raising the bow arm to shoulder height and holding it straight, but not locked. Keep your head facing the target. Draw the bowstring backward toward the center of the chin. The thumb and little finger of the bowstring hand should not touch the bowstring, and the bow hand should be pushing the bow, not gripping it. 5) Release. Do not release the arrow until the leader gives the command to shoot. When the archer is ready to shoot, release the arrow by relaxing the drawing fingers. 6) Follow-through. Follow-through means holding the release position until the arrow is safely imbedded in the target. This prevents body movement from affecting the arrow's direction. 7) Retrieving. Archers should not retrieve their arrows until everyone has shot and the leader gives the command to retrieve. When removing an arrow from the target, place your

4.3
Target Shooting
Technique (Continued)

4.3
finger on the target face next to the arrow before pulling the arrow out.

4.4
Bow Practice

4.4
After demonstrating the proper procedure for standing and drawing the bow, allow the students to handle the bows. Do not allow students to place the arrow in the bow while in the classroom. Allow each student an opportunity to draw the bow, without an arrow. The more familiar the students are with the feel and force required to draw the bow, the better they will be able to function when allowed to use the arrow.

4.5
Target Scoring

4.5
Once beginning archers have mastered the fundamentals for handling the bow and arrow, they will desire to compete with others for the best score.

Archery targets are 48 inches in diameter, consisting of five concentric circles.

Make either a transparency or student copies from the target diagram (Appendix E) and briefly discuss the point values of each circle. From the outside inward, the point values are 1, 3, 5, 7, and 9 (bullseye). The color pattern from outer circles inward are white, black, blue, red, and gold.

During competition, each archer shoots six arrows for an end. If more than six arrows are shot, only the six with lowest scores are recorded. Scores are kept by adding the point value of each circle in which an arrow is located.

If an arrow passes completely through the target, it is given seven points. An arrow that bisects a line between two colors is given the higher point value. When an arrow rebounds from the target, it is worth seven points.

Draw some target diagrams on the chalkboard. Place six points, representing arrows, on each of the targets and have the students find the score of each.

4.6
Clout Shooting

4.6
Clout shooting is a form of archery where the archer shoots at an area or target on the ground at great distances. This type of shooting was used in battles where one side was protected by high walls. The attacking archers would shoot high over the walls and in some cases would shoot arrows with fire attached to them, hoping to burn the other group out.

4.6
Clout Shooting
(Continued)

4.6
The target, instead of being 48 inches in diameter, is about 48 feet in diameter. The target rings are made by mowing or marking lines on the grass. The center of the middle ring is marked with a small flag or marker. The archers shoot from a distance of from 50 to 100 yards. Each archer will shoot two arrows and attempt to place his arrows in the circle marked on the range.

To be successful in this type of shooting, one must shoot into the air with a great deal of arch, as illustrated in the diagram below.

The one safety rule so necessary in this type of shooting is never shot or aim directly overhead or nearly straight up. Other rules are the same as on a regular archery range.

4.7
Values of Archery

4.7
Have the students list benefits they can gain from archery. Use these as hints for the students: exercise, social meeting of people, sport competition, fun, lifetime activity, and family sport. Be sure to bring out the following ideas.

Unlike many sports that require teams, strong physical ability, or expensive equipment, archery can be enjoyed by individuals of all ages and with very little equipment. For those wishing to be with groups, archery clubs are available in most areas, and sponsor competition between various age groups.

People that regularly participate in archery develop good physical structure. Archery helps develop and maintain proper posture and ability to concentrate. The abdominal and back muscles are well developed as a result of drawing on the bowstring. Other exercise is gained as a result of walking and bending during target practice. With our present day demands on the environment, archery is a very environmentally sound sport, as it does not destroy the environment in which it is performed.

4.8
History of Archery

4.8
The origin of archery is unknown. Archaeologists estimate that archery was known at least 100,000 years ago. The bow and arrow is one of man's oldest mechanical weapons and remains the weapon of many primitive tribes in Africa and South America. It was the chief weapon of American Indians for hunting and war. It was used as a weapon of war by the Egyptians in overthrowing Persia and many other successful wars.

With the discovery of powder and the use of fire arms, the bow was retired to the realm of sport. The earliest contest in archery was held in England in 1673, by the "Ancient Searton Arrow Society." This tournament remains the oldest in existence.

The first archery club in the United States, called the United Bowman of Philadelphia, was organized in 1828. The National Archery Association was founded in 1879 in Crawford, Indiana, and the first tournament was held in 1879 in Chicago. This tournament is sponsored annually by the N.A.A.

Archery has carry-over fascination for most people from childhood Indian-playing days. Archery represents adventure and excitement; one needs only to recall the adventures of Robin Hood, William Tell, and Hiawatha.

Archery continues to hold interest as a sport for several reasons: 1) the evolution of a new method of shooting which is easier to learn and more accurate than the old; 2) the development of more efficient bows and arrows; 3) the fascination many people find in the activities possible to the archer, ranging from target shooting, clout (long distance shooting into a circle), roving, archer-golf, and novelty shoots, to the actual hunting of small and large game.

4.9
Archery Associations

4.9
As a special project, have a student or small group contact the local archery club. The students could inquire about membership cost, membership requirements, types of activities available, location of club activities, and other information.

Information about the National Archery Association can be obtained by writing: National Archery Association, 2833 Lincoln Highway East, Ronks, Pennsylvania, 17572.

APPENDIX A

Film Summaries

Before using any of the following films in the classroom, read the summaries provided. The brief reviews of the films will allow you to select those that are best suited for your students and method of presentation. The words and questions provided in each summary are not intended to be a complete guide, but rather an aid to the teacher in directing students during viewing and discussion activities.

Unless stated otherwise, the films are located in the Topeka Public Schools Film Library. Have your media specialist obtain them for you.

Before the students view the film, direct their attention toward the specific concepts or ideas you want them to gain, otherwise they tend to only watch a "movie." By stopping the film during the viewing, emphasis can be added to special concepts or examples. Another useful tool in showing short films is to show the complete film, have a discussion, then view the film a second time with everyone looking for those specific examples, concepts, or ideas that were discussed.

These films were selected because they were readily available and illustrated the desired concepts. Other films can be used with equal or better results.

The supply of film strips that are available and could be useful supplements for the unit material, are too numerous to list. Your media specialist has available, a list of film strips located within each building. Filmstrips can be obtained from other buildings for your use.

Geology

Rocks That Reveal the Past A-1

Rocks That Form On Earth's Surface A-2

Understanding Our Earth: Soil A-3

Understanding Our Earth: How Its Surface Changes A-4

Fossils Are Interesting A-5

Prehistoric Times: The World Before Man A-6

Our Changing Earth A-7

Time, Lines, and Events A-8

Rivers and Reservoirs

Birth of a River A-9

Animals and Plants

Putting Animals in Groups A-10
Butterfly and Moth Life Cycles A-11
Birds Are Interesting A-12
Mammals Are Interesting A-13
The Living Mammals A-14
Animals Protect Themselves A-15
Animals in the Autumn A-16
The Seasons of the Year A-17
Animals And How They Communicate A-18
World In A Marsh A-19

Sunlight A-21
Life of a Plant A-22

ROCKS THAT REVEAL THE PAST

12 min. - color - Film Association

This film contains excellent examples of rock layers within the Grand Canyon. Presents illustrations of four types of fossils; fossil bone, imprints, cast, and petrified wood. Good illustrations of how relative age of fossils is determined. Students will need teacher guidance in order to understand portions of the film.

New words and words for discussion:

cast
fossil
imprint
petrified
sediment
tilted layers
weathering

Suggested questions for discussion:

1) Are the present day seas and oceans in the same location they were thousands of years ago?

2) What causes the weathering of rocks?

3) Describe some ways water affects rocks.

4) What is sediment?

5) Why do scientists study the contents of rock layers?

6) What type of rock layers contain fossils?

7) Describe four types of fossils and explain how each is formed.

8) How do scientists determine what prehistoric plants and animals looked like?

9) How do scientists decide which types of plants and animals lived first?

10) Is petrified wood composed of wood?

11) Why do scientists like to study rocks in the Grand Canyon?

12) Which rock layers are older, top layers or bottom layers?

13) Was the first life believed to be on land or in the seas?

14) Why are rock layers different?

15) Why are some rock layers tilted? Were they deposited this way?

16) What kind of rocks are found in the Grand Canyon?

ROCKS THAT FORM ON EARTH'S SURFACE

16 min. - black and white - Encyclopedia Britanica

A rather difficult film for elementary students to understand without considerable guidance, but does present several good illustrations. The concepts can be discussed without using the same terminology used in the film.

Suggested questions for discussion:

1) Where does the "stuff" that causes water to be dirty come from?

2) What are some of the factors that cause rocks to break up?

3) Can slow moving water carry as much water as fast moving water?

4) What is gravity?

5) What is needed to change soft sediment into rocks?

6) What is time lapse photography?

7) What fastens the sand grains together in rocks?

8) What kind of rocks form when dust and "stuff" settle to the bottom of lakes or other bodies of water?

9) Will all plant material that settles to the bottom of lakes and streams form coal deposits?

10) Why can sea shells be found on mountains?

UNDERSTANDING OUR EARTH: SOIL

11 min. - black and white - Coronet

A good presentation on the role of topsoil and its formation. Brings out the breaking down of rocks by weathering process of heating, cooling, physical force, water, and plants.

New words and words for discussion:

conservation
topsoil
subsoil
bedrock
humus
clay
weathering
contour

Suggested questions for discussion:

1) How does topsoil differ from the subsoil?

2) What kind of material is just below the subsoil?

3) In which layers do plants grow?

4) How does the soil quality and the plant growth relate?

5) List some of the things found in good soil.

6) From what is soil made?

7) What happens to rocks when they are heated by the sun and then cooled by rain?

8) When water freezes, does it require more space?

9) How does the freezing of water affect rocks?

10) Describe two ways water helps break up rocks.

11) How do plants aid in the breaking up of rocks?

12) What is humus?

13) Is all soil the same?

14) What is soil conservation?

15) Can a tree root actually grow into a rock?

16) Why do we have different kinds of soil?

17) Why practice soil conservation?

18) How long does it take to make topsoil?

19) Where are some local examples of soil formation occurring?

UNDERSTANDING OUR EARTH: HOW ITS SURFACE CHANGES

11 min. - black and white - Coronet

Good illustrations of the forces that build up and wear down earth structures are presented. Special emphasis is placed on the effects brought about by wind and water.

Suggested questions for discussion:

1) Are the earth's surface structures changing? How?
2) How does water change the earth's surface?
3) What does it mean when we say rocks dissolve in water?
4) What happens to rocks when water freezes in the cracks?
5) How does wind affect the earth's surface?
6) What evidence justifies our belief that shoreline locations have changed?
7) Do mountains last forever?
8) How can wind and water damage the soil?
9) What affect does wind and water damaged soil have on man's food supply?
10) What happens to the dirt water is carrying when the water slows down?
11) What forces are building up soil and mountains?
12) What forces are wearing away soil and mountains?
13) Will the earth's surface appear the same 9,000 years from now?
14) Give a local example of building up and wearing away of the earth's surface.

FOSSILS ARE INTERESTING

8 min. - black and white - Film Association

This film illustrates methods by which fossils are formed and some good record keeping procedures. There are several good points in the film, but it also contains some poor fossil collecting procedures. The students in the film do not wear eye protection when hammering rocks, are very careless about allowing rocks to roll down hill, and do not spend time looking for fossils on the surface. The road cuts used in the film is much richer in fossils than most places, therefore students may be disappointed when they go to Calhoun Bluffs and cannot find as large or as many fossils as shown in the film.

Suggested questions for discussion:

1) How can we explain finding fossils of sea animals on mountain tops?

2) Will our present types of animals always be present on the earth?

3) What are fossils?

4) What is sediment?

5) Where are good places to look for fossils?

6) What kind of rocks will contain fossils?

7) What is an imprint?

8) Why is it important to keep good records of fossil finds?

9) What does the word extinct mean?

10) What is petrified wood? How does it form?

11) Find a fish imprint, tell about the area in which it is found.

PREHISTORIC TIMES: THE WORLD BEFORE MAN

8 min. - black and white - Coronet

Several good illustrations, such as the crinoid, are presented. This film will supplement the earth calendar or earth clock diagrams very well. Words such as the names of the eras are presented, but can be ignored during class discussion.

Suggested questions for discussion:

1) What information does a scientist use in deciding what a prehistoric plant or animal looked like?
2) What forces are building up the earth's surface?
3) What forces are wearing down the earth's surface?
4) Has the ocean always been the same shape?
5) Where is it believed the first life appeared?
6) What shape of life is believed to have appeared first?
7) How does the lung fish differ from other fish?
8) What type of plants are believed to have formed our coal deposits?
9) What types of changes do scientists use to divide the eras?
10) Were amphibians or fish present on the earth first?
11) Place the following in the order they are believed to have appeared on the earth. Man, fish, animals without back bones, birds, mammals, amphibians, and reptiles.

OUR CHANGING EARTH

11 min. - black and white (reddish color) - Film Association

Excellent illustrations of the past plant and animal life types are presented. A large volume of material is presented in a short time and students will need a good follow-up discussion. Do not be concerned about the various scientific names, but expand in the general pattern changes.

Suggested questions for discussion:

1) Why do scientists study fossils?
2) What part of a fossil can be used to determine the type of food an animal eats?
3) When a scientist finds many fish and clamlike fossils, what does he know about the history of the area?
4) Why do scientists believe there were very few land animals before the amphibians?
5) What kind of life is believed to have appeared first?
6) Why do we know so little about the soft bodied animals of the past?
7) Did the first land plants have flowers?
8) What type of climate did the amphibians need?
9) Did man or flowering plants appear first?
10) Is the earth still changing?
11) Have the oceans always been their present size?
12) Why did the earlier forms of plants and animals die?
13) Why is one period called the age of fish?
14) Are dinosaurs reptiles or amphibians?

TIME, LINES, AND EVENTS

19 min. - color - Churchill

This film discusses the relative ages of the earth, dinosaurs, and man. No attempt is made in the film to explain how the relative ages were determined. Some of the terminology used in the film can be ignored without losing the important concepts. Using the earth calendar or earth clock diagram while discussing this film will help the students grasp the relative amounts of time involved.

Suggested questions for class discussion:

1) Did life appear on the earth when it was first formed?

2) How old is the earth?

3) What kinds of life are believed to be among the first?

4) Which came first, jellyfish or dinosaurs?

5) What was the world like when the first life appeared?

6) What type of life first appeared during the ice ages?

7) What is a trilobite?

8) Were the dinosaurs still around when man appeared?

9) Did life exist in water or on land first?

10) What kind of plants were living on the land when the dinosaurs were common?

BIRTH OF A RIVER

12 min. - color - Turnbull Productions

Good illustrations relating the water cycle and land formations to the rivers. This film will need teacher guidance as it moves quickly from one topic to the next. Centers around the major rivers and does not discuss importance of small streams.

New words and words for discussion:

watershed
condensation
ground water
precipitation
aquifer
saturated air
evaporation
spring

Suggested questions for discussion:

1) Name five ways man uses rivers.

2) Why are mountains important to United States?

3) Are clouds important?

4) Does all water that falls as rain run into rivers?

5) How does snowfall help our water supply?

6) What are some ways reservoirs help man?

7) Why are some rivers clear while others are dirty?

8) What are some factors that affect how much water flows into a river?

9) Where do most rivers start?

10) Which river in Kansas starts in the mountains?

11) What part of the rainfall flows into rivers? Where does the other water go?

PUTTING ANIMALS IN GROUPS

9 min. - color - International Film Bureau

This film places animals into six groups and describes the characteristics of each group. The discussion of the invertebrate group is rather weak. Variations of the groups are well illustrated and easy for students to follow.

Suggested questions for class discussion:

1) Why are animals put into groups?

2) Name the six groups of animals.

3) How is a cold blooded animal different than a warm blooded animal?

4) Which group lives entirely under water?

5) Do all animals have backbones?

6) Where do amphibians lay their eggs?

7) Where do reptiles lay their eggs?

8) What do all mammals have in common?

9) What does the word structure mean?

10) What are some examples of mammals? reptiles? fish? amphibians?

11) Are spiders insects? Why?

12) Which group does man belong to?

13) Match the following characteristics with the group (s) they belong to:

(a) have feathers

(b) produce milk

(c) have hair

(d) have moist skin

(e) warm blooded

(f) have backbones

(g) have lungs

(h) have six legs

(i) have outside skeletons

(j) have gills

(k) cold-blooded

(l) lay eggs

(m) have bills or beaks

(n) have scales

(o) have fins

BUTTERFLY AND MOTH LIFE CYCLES

13 1/2 min. - color - Coronet

A brief summary of the butterfly and moth body structure is presented and then followed by a good description of the life cycle of one example from each group. This is an excellent film for illustrating adaptations, similarity, variations, and life cycles.

New words and words for discussion:

Lepidoptera
antenna
molting
chrysalis
pupa stage

Suggested questions for class discussion:

1) From what characteristic was the word lepidoptera derived?

2) Describe how the scales of a butterfly fit together?

3) How many body parts or sections do moths have?

4) Do the butterflies and moths have the same number of legs? How many do they have?

5) Do the butterflies have just two eyes?

6) What part of their body is used to smell?

7) Where are the taste organs located?

8) Are both the butterflies and moths active during the day?

9) Which holds their wing open while resting?

10) Which is usually brighter colored?

11) How does the antenna of the butterflies differ from the moths?

12) Why does the red admiral butterfly lay its eggs on the thistle?

13) How does the young butterfly differ from the adult?

14) Does the temperature affect the rate of chrysalis development?

15) How does the food of the adult butterfly differ from the food of the caterpillar?

16) Do the moths feed in groups or as individuals?

17) Why does the moth caterpillar tie the leaf in which it will spend the winter to the branch?

18) How does the moth cocoon differ from the butterfly cocoon?

BIRDS ARE INTERESTING

11 min. - color - EBE

This film relates structural adaptation to the life habits of the various groups of birds, especially the bill and feet specialization.

New words and words for discussion:

resident bird	predatory
migratory bird	birds of prey

Suggested questions for class discussion:

1) What characteristic do all birds have?

2) Can all birds fly? Give an example of a bird that does not fly.

3) How do resident birds differ from migratory birds? Which group do geese belong to?

4) Name a bird that is at home in water. How does this bird use its wings?

5) What type of food does a bird eat that has a very strong and curved bill?

6) What kind of feet do predatory birds have?

7) How does a bird, like a hawk, help man?

8) For what do birds, like the quail, use their feet?

9) Where would you find a bird with webbed feet?

10) What kind of legs do birds that live along shorelines have?

11) In what area would you find fruit eating birds?

12) Birds that live in the grassland, but cannot fly, like the Emu, have very well developed what?

MAMMALS ARE INTERESTING

12 min. - color - EBE

Variations, similarities, and adaptations of various groups of mammals are well illustrated. This film explains the characteristics that all mammals have in common and how they differ from other vertebrates.

Suggested questions for class discussion:

1) Do all organisms have backbones?

2) Does a cold blooded animal always have cold blood?

3) How does a cold blooded animal differ from a warm blooded animal?

4) How do fish differ from reptiles?

5) How do birds differ from reptiles?

6) Do all mammals have backbones?

7) Are people mammals?

8) Which group of organisms has hair?

9) Which group of organisms feeds their young milk?

10) Why are sealions not called fish?

11) Does the type of teeth a mammal has vary with the type of food they eat? Give some examples.

12) Which group of mammals is considered most intelligent?

13) Describe some ways mammals' feet vary with the way they live.

THE LIVING MAMMALS

17 min. - color - International Film Bureau, Inc.

An easily understood film that is enjoyable to view. This film gives a good description of several common mammals. There is a large amount of content ranging from description of variations, similarities, adaptations, and groupings. Film slightly long.

New words and words for discussion:

herbivores
carnivores
omnivores
cud
hibernation
rodent
marsupial
insulation

Suggested questions for class discussion:

1) What is different about warm blooded animals compared to cold blooded animals?

2) Which groups of animals are warm blooded?

3) What two characteristics do mammals have that no other group of animals has?

4) Name two examples of mammals that live in the oceans.

5) Name a mammal that flies.

6) Describe the feet of large mammals that live in a grassland.

7) How does the eye location of the deer differ from the eye location of the coyote? How does the location help each animal?

8) What senses do animals use in watching for enemies?

9) Which teeth of the fox is most highly developed? How does the fox use these teeth?

10) Which teeth are most highly developed in the deer? How does it use these teeth?

11) What is cud? What kind of animal has cud?

12) Name some examples of rodents. Which teeth do they have most highly developed?

13) How do carnivores differ from herbivores?

14) Describe some ways mammals prepare for winter.

15) How do marsupials differ from other groups of mammals?

16) A mammal that eats both plants and meat belongs in which group, herbivores, carnivores, or omnivores?

17) Describe some ways mammals protect themselves from their enemies.

18) How does hibernation differ from regular sleep?

19) Is man a mammal?

20) Why do beavers build dams?

21) Do most mammals protect and feed their young?

ANIMALS PROTECT THEMSELVES

11 min. - color - Coronet

The various ways animals protect themselves are illustrated as a father and son walk through a wildlife preserve. Body structure, protective coloration and fighting are the principal methods illustrated.

Suggested questions for class discussion:

1) What two ways did the rabbit use to protect himself?
2) Where do rabbits locate their nest?
3) What behavior did the killdeer use to draw enemies away from its nest?
4) How do most birds escape danger?
5) Why does a ground squirrel's nest have more than one exit?
6) Name some animals that can hide in their shells.
7) How does the porcupine defend himself?
8) Does a skunk run away from danger?
9) What is protective coloration or camouflage?
10) Why is a walking stick hard to see?
11) Name some animals that fight to protect themselves.
12) Describe the special way each of the following animals protects himself: squirrel, duck, hornet, skunk, bear, and buffalo.

ANIMALS IN THE AUTUMN

11 min. - color - EBE

This film illustrates some of the ways animals prepare for and survive in the winter. Some of the methods illustrated are migration, hibernation, laying eggs, partial sleeping, food gathering, and coloration changes.

Suggested questions for class discussion:

1) Name three groups of animals that migrate during the fall.

2) How do most insects survive during the winter?

3) Where would you look for grasshopper eggs?

4) How do bees prepare for the winter?

5) From what do bees make honey?

6) Where would you find the turtles and frogs during the winter?

7) Do fish hibernate?

8) What happens to cold blooded animals during the winter?

9) Do cold blooded animals need as much food during the winter?

10) Name some animals that semihibernate.

11) Describe a winter food chain.

12) Why does the color of some animals change in the fall?

13) What do deer eat during the winter?

14) What happens to the hair on most mammals during the fall and winter?

15) During which season will most animals be the fattest?

16) During which season will animal hides make the best furs for coats, etc.

17) Do any animals die during the winter? Why?

THE SEASONS OF THE YEAR

9 min. - color - Coronet

This film will help students review seasonal changes of plants, animals, weather, and sun's location, and could be used rather effectively when discussing seasonal cycles. The film is easily understood by students and will help increase their observation of seasonal characteristics.

Suggested questions for class discussion:

1) Name the months included in each season; summer, spring, fall, and winter.

2) What is another name for fall?

3) How do the temperatures in the fall compare with the temperatures in the spring?

4) What happens to many plants during the fall?

5) How does the fall affect birds?

6) Describe some of the activities man does during the winter?

7) What is a thunderstorm?

8) During which season can we expect the most thunderstorms?

9) During which season is most wildlife born or hatched?

10) Fruit is produced during which season?

11) What season is it if trees have only small leaves?

12) Animals have the thickest fur during which season?

13) Tree buds open during which season?

14) During which season are shadows the largest?

15) In what form do most insects exist during the winter?

ANIMALS AND HOW THEY COMMUNICATE

11 min. - color - Coronet

Various ways animals use sight, sounds, and movements to communicate with other animals are illustrated in this film. The film is enjoyable viewing and easy to understand.

Suggested questions for class discussion:

1) What are four different types of information animals communicate to each other? (fear, presence, alarm, and mating)
2) How does communication help animals survive?
3) What does the flicking of the meadow lark tail indicate?
4) How does the redwing blackbird defend the territory he claims?
5) Why does a female killdeer often act as if one wing is broken?
6) What do the crows do when a hawk approaches?
7) How do geese prevent the group from separating?
8) Do beavers splash their tail just for fun?
9) What is a prairie dog saying when he barks rapidly and flicks his tail?
10) What is the antelope thinking if you can see its white rump patches?
11) How does a bee tell the others in the hive where it found the best nectar?
12) Many birds do elaborate dance displays. Why do they perform this way?
13) Which is usually more colorful, the male or female?
14) Can ants hear?
15) How do grasshoppers produce sounds?

WORLD IN A MARSH

30 min. - color - McGraw-Hill

This film is very colorful, and generally easy to follow. Teacher guidance will be needed to review the large number of concepts illustrated. Most of the natural relationships, except decomposers, that would be found in any habitat, are included in this illustration of marsh life.

Suggested questions for class discussion:

1) Is the dragonfly a predator?

2) Can the dragonfly be prey? For what kind of animal?

3) What are some examples of competition? (for mates, for food, for space)

4) Where is the bullfrog's ear?

5) Why does the big sack form below the jaw of a frog when it croaks?

6) If there are 200 frogs in the pond one year, how many do you expect the next year?

7) Where does the dragonfly lay its eggs?

8) Why do people destroy areas like the marsh?

9) How does a marsh help the area surrounding it?

10) Do all frogs make the same type of sound?

11) What animal eats dragonfly eggs?

12) In what part of the country was this film photographed?

13) What type of plants are most common in a marsh?

14) What are some predator-prey relationships illustrated in the film?

15) Are any decomposers illustrated in the film?

16) Name some producers found in a marsh.

17) How is a frog and duck similar?

18) How does a baby duck and baby blackbird differ?

19) What eats frogs?

20) Describe the life cycle of a dragonfly.

21) Name some special adaptations of animals that live in a marsh.

22) What kind of food does a duck find in a marsh?

23) What kind of life can be found on the bottom of a marsh?

24) What is larva?

25) Why do male bullfrogs fight with each other?

26) What type of nest does the grebe build?

27) Do all eggs hatch and survive?

28) What is necessary in order to have a marsh?

29) Why do the birds chirp at night?

30) Describe four food chains illustrated in the film.

31) Diagram a food web for a marsh similar to the one illustrated.

SUNLIGHT

9 min. - color - BFA

Sunlight is a good film to combine music, art, and science. It could be followed by some music and art activities. This is a very colorful film and enjoyable to view, but does not strongly bring out the importance of sunlight in food production. Several other ways sunlight affects our lives are discussed.

Suggested questions for discussion:

1) Could we see without sunlight?

2) Does the sun shine on cloudy days?

3) Is sunlight white or composed of colors? How do we know?

4) During which season was the lake scene photographed?

5) Which season has the longest days?

6) Does all life need sunlight?

7) When are the shadows shortest?

8) How do morning and evening shadows differ?

9) Could there be day and night without the sun?

10) Does our food supply depend on the sun?

11) What causes a rainbow?

12) Would the earth's temperature be different if the sun did not shine?

13) Describe what you think the earth would be like if there were no sun.

LIFE OF A PLANT

9 mon. - color - EBE

If followed by a good class discussion, this film will help students understand the plant life cycle and the many ways plants interact with various parts of their environment in the process of living. Some rather scientific terminology is used, but can be ignored during class discussion.

Suggested questions for class discussion:

1) From where do plants get their minerals and water?

2) What part of a root continues to grow?

3) In what way does a root help the plant?

4) From where does a plant get carbon dioxide?

5) What substance is returned to the air by green plants?

6) What is manufactured in the plant leaves?

7) From where do the roots get their food?

8) What is photosynthesis?

9) What must happen before a seed can be produced?

10) Is sunlight necessary for a plant to produce sugar?

11) Do we depend on green plants? What for?

12) Starting with the seed, describe the various steps a plant goes through before it produces new seeds.

APPENDIX B

Geology

The items in Appendix B are intended for use with Topic I, Geology. The diagrams, pictures, and charts can be used to make transparencies, student handouts, or used in bulletin board displays.

Suggested uses are included in the discussion found in Topic I. The teacher should feel free to use the items in any way they find useful.

Rock Cycle Diagram B-1

Diagram of Wind Eroded Rock Formations B-2

Diagram of Root-Spreading Rocks. B-3

Fossil Diagrams. B-4

Skeleton Diagram I (Horse) B-5

Skeleton Diagram II (Prehistoric Beaver) B-6

Skeleton Diagram III (Diadectes and Moschops). B-7

Geological Time Chart - Animals. B-8

Geological Time Chart - Plants B-9

Sequence Pictures (3 pictures) B-10

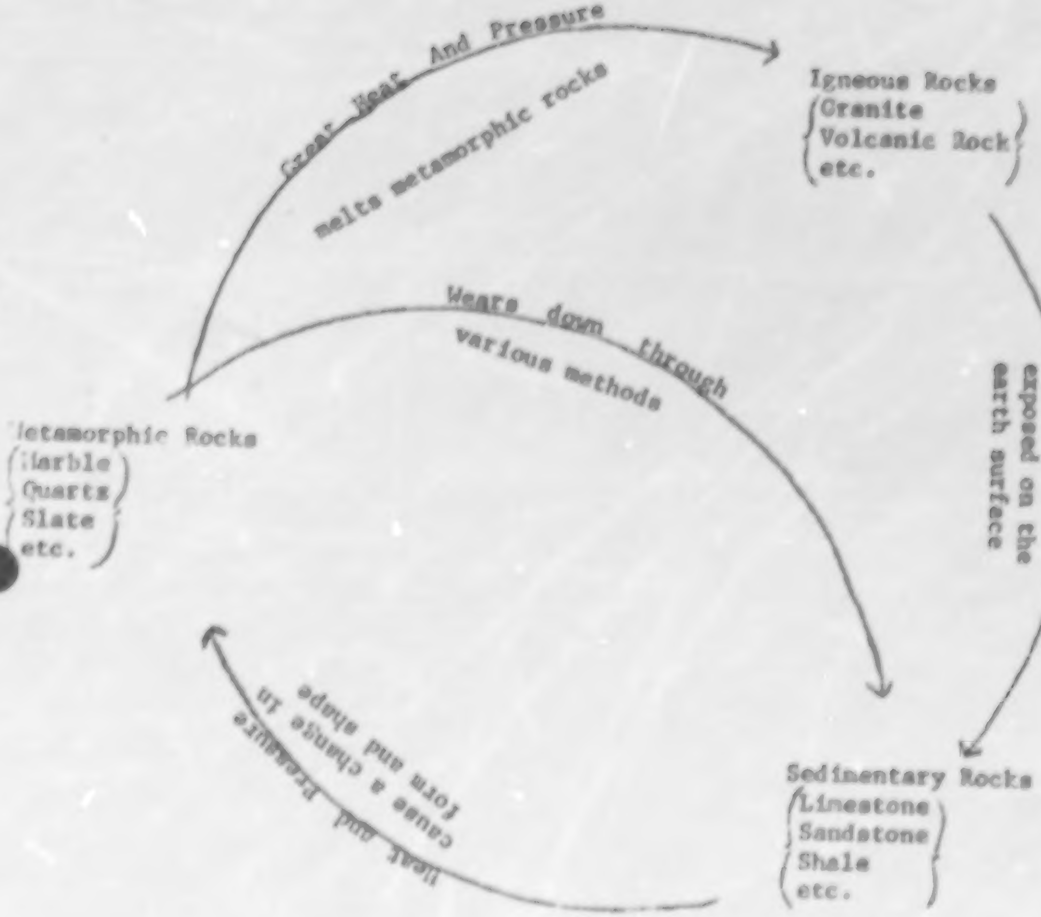
Geological Time Table. B-13

Earth Clock. B-14

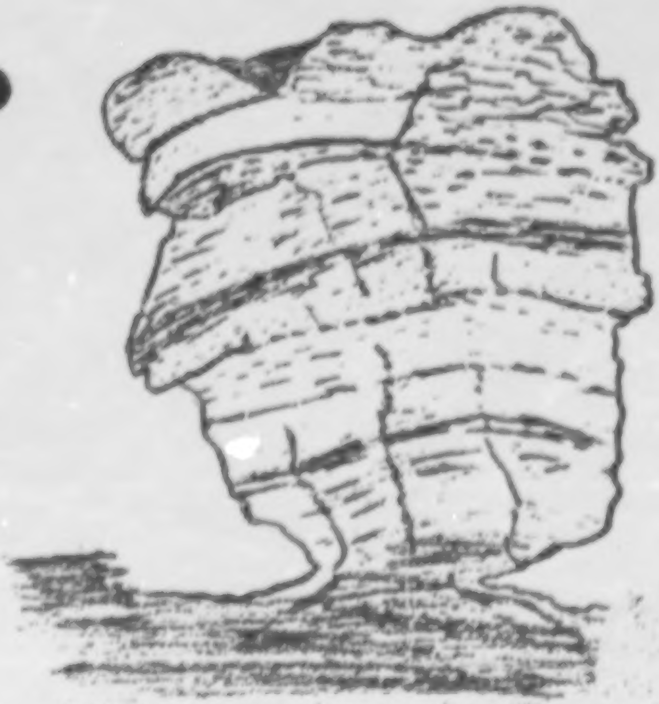
Earth Calendar B-15

Calhoun Bluffs Formation Diagram B-16

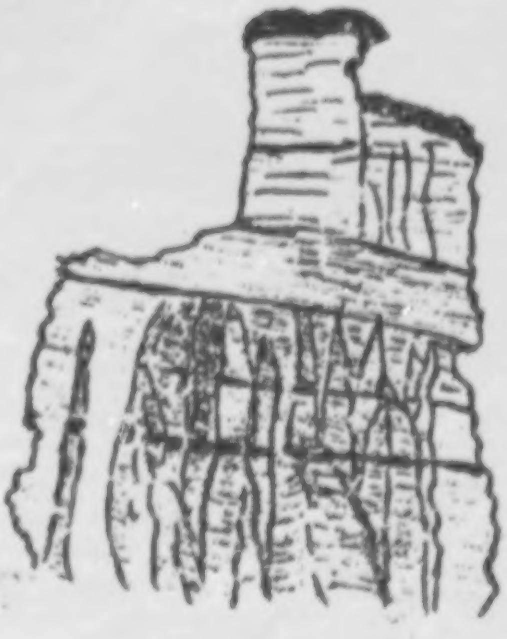
ROCK CYCLE


Igneous Rocks
Granite
Volcanic Rock
etc.
Breaks up when exposed on the earth surface
Sedimentary Rocks
Limestone
Sandstone
Shale
etc.
Heat and Pressure cause a change in form and shape
Metamorphic Rocks
Marble
Quartz
Slate
etc.
Great Heat And Pressure melts metamorphic rocks
Wears down through various methods

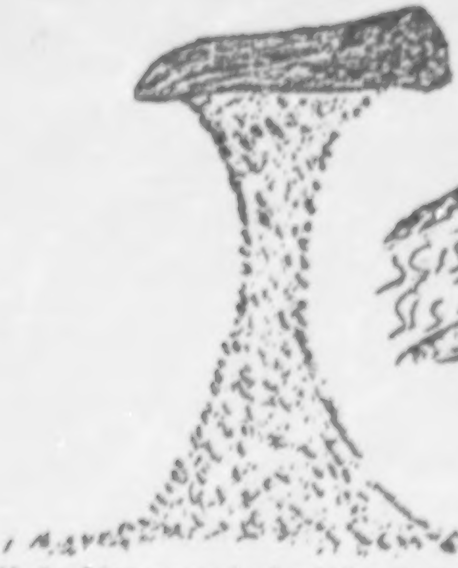
WIND ERODED ROCK FORMATIONS



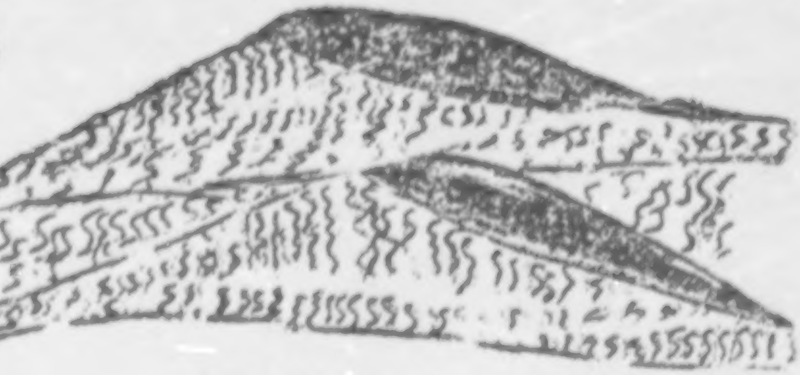
A) Variation in hardness and resistence to weathering by different layers.



B) Variation in weathering of layers and weathering along vertical cracks.

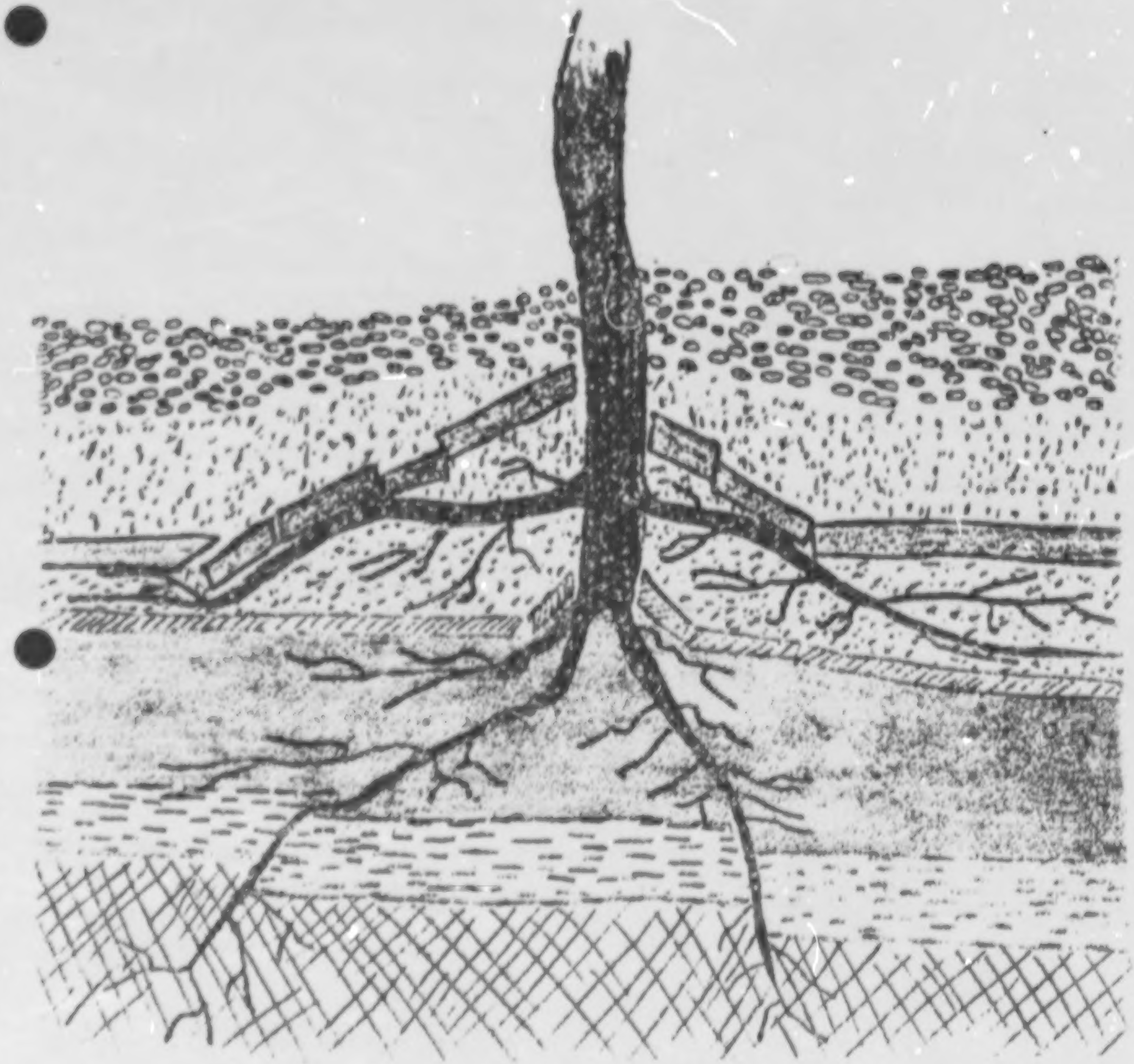


C) Boulder capped glacial material soft material being eroded from under boulder.

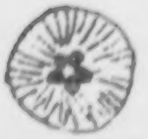


D) Wind blown sanddunes.

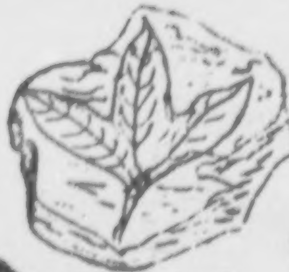
ROOTS SPREADING ROCKS



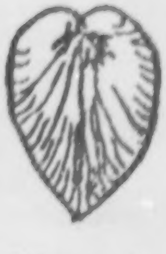
FOSSIL DIAGRAMS



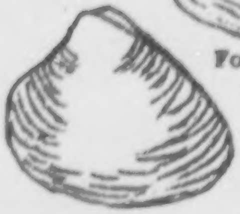
Crinoid Stem



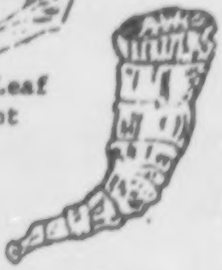
Fossil Leaf
Imprint



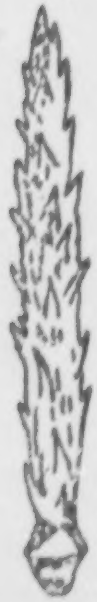
Pelecypod
(side view)



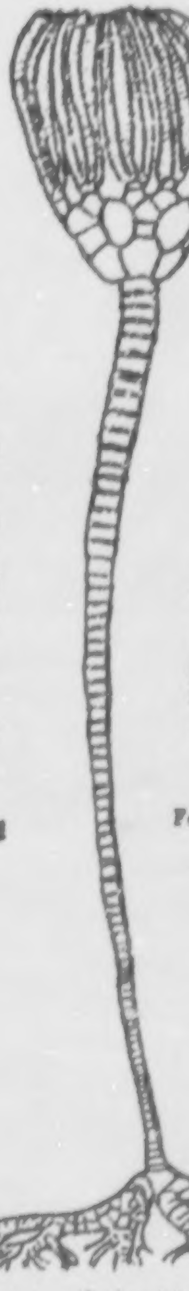
Pelecypod



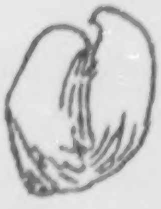
Coral



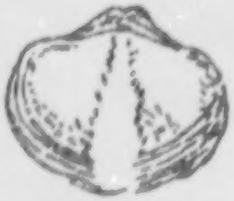
Echinoid
Spine



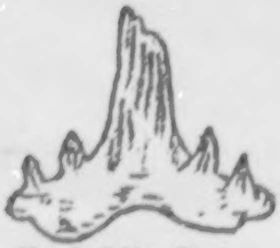
Crinoid



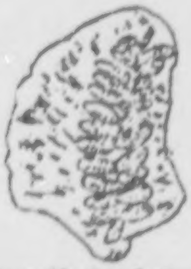
Brachiopod
(side View)



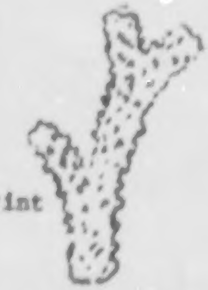
Brachiopod



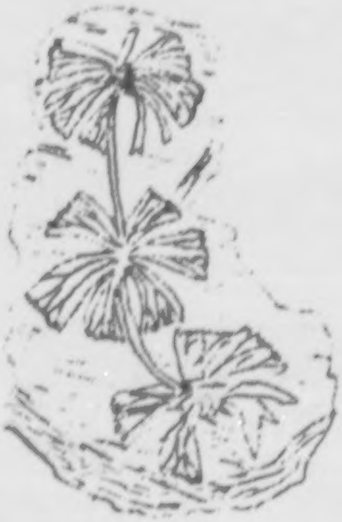
Shark-like fish
tooth



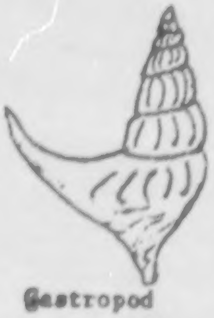
Fossil Leaf Imprint



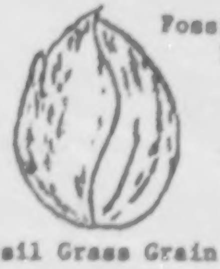
Bryozoan



Fossil Plant
Imprint

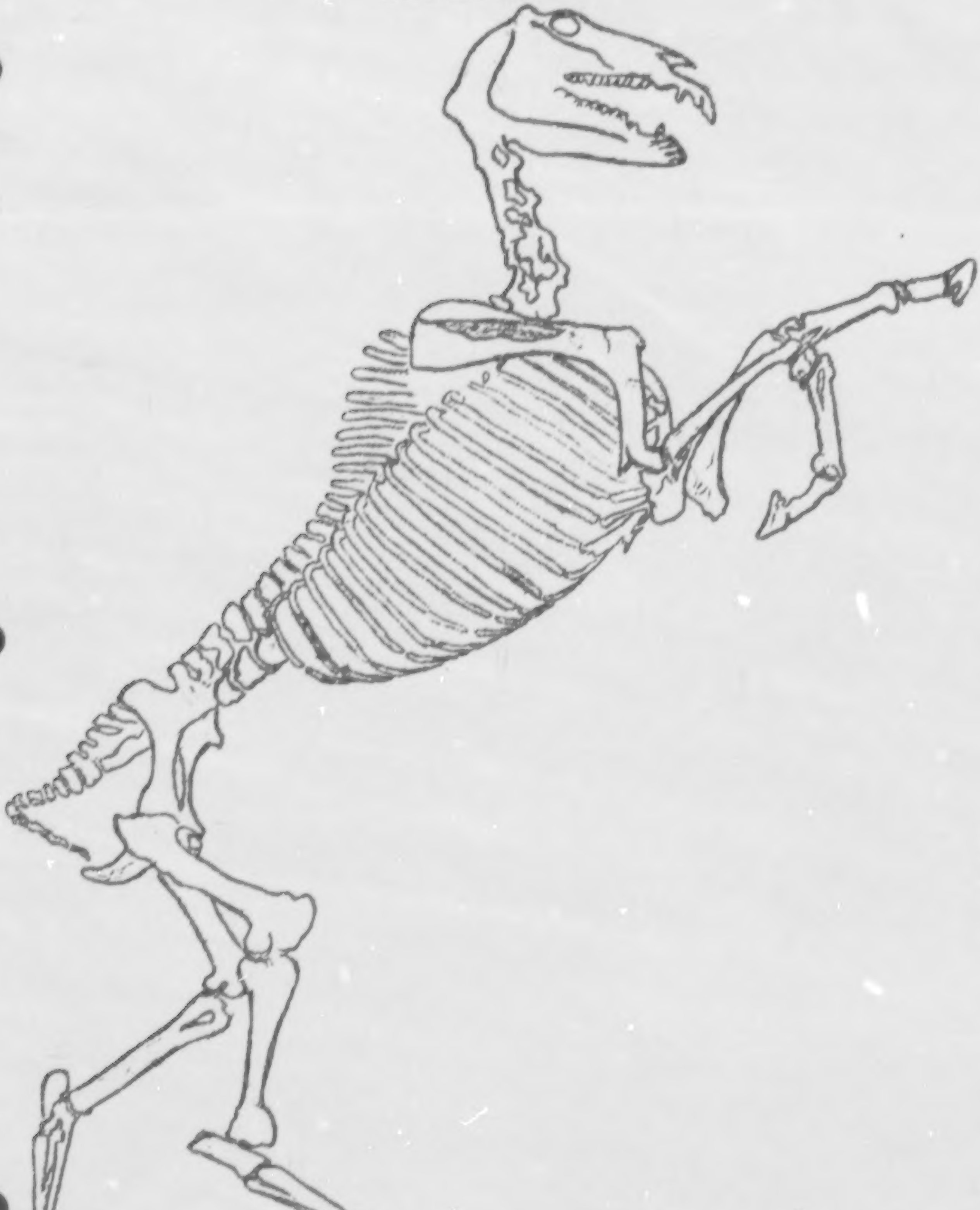


Gastropod

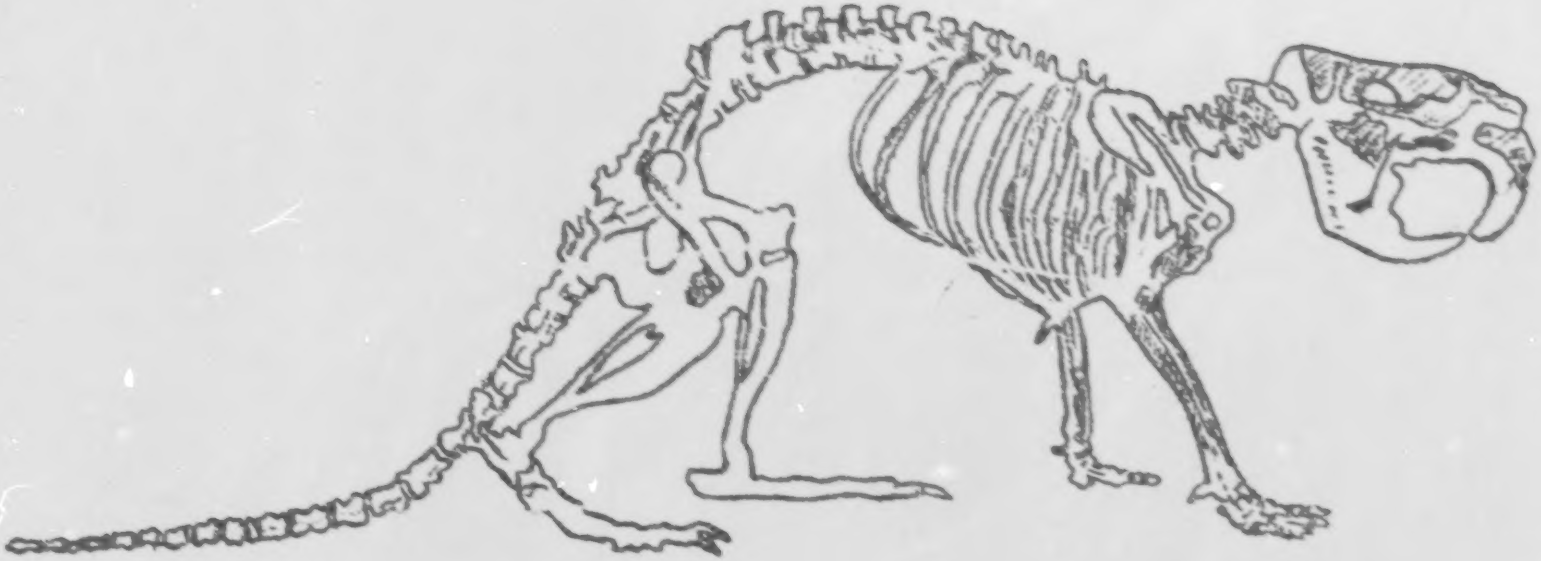


Fossil Grass Grain

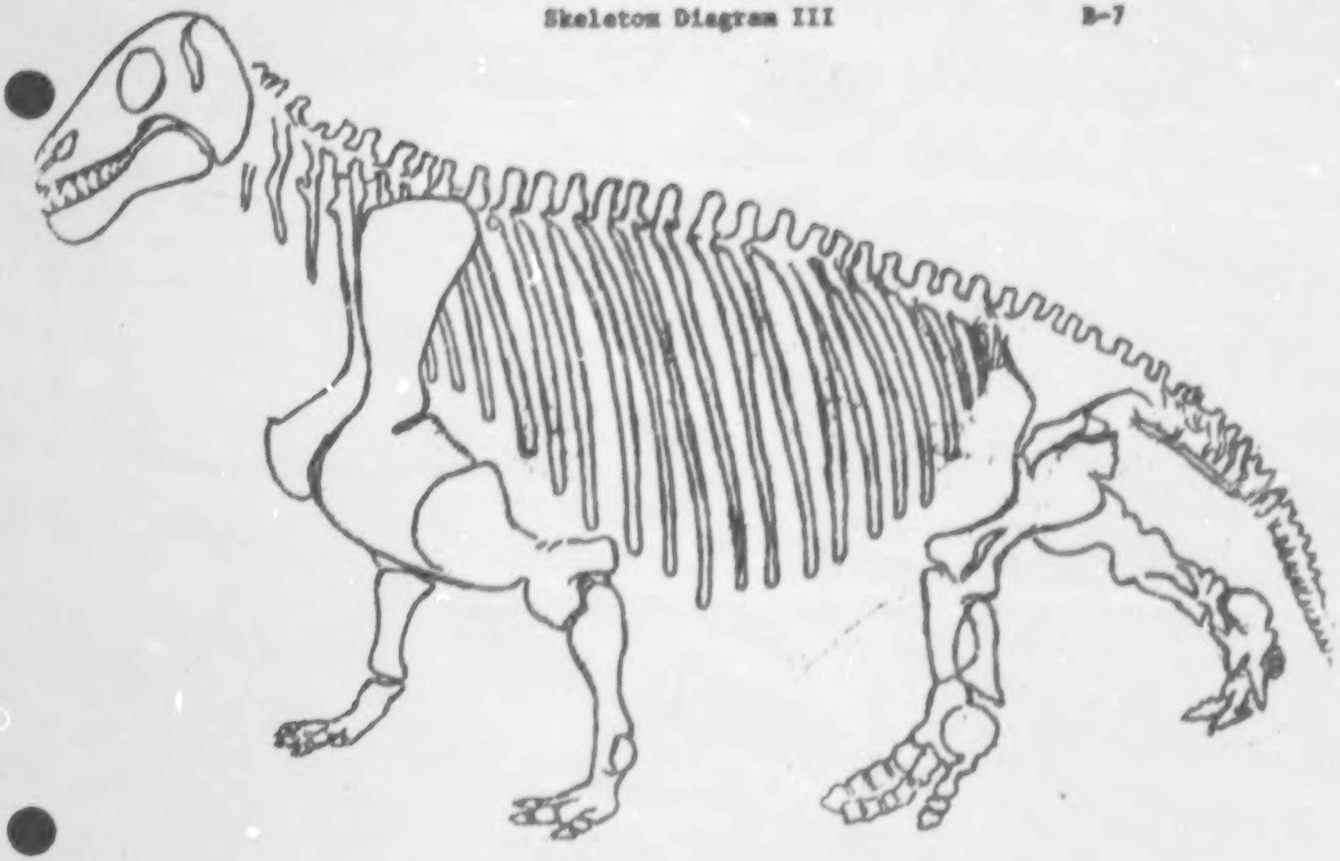
Skeleton Diagram I

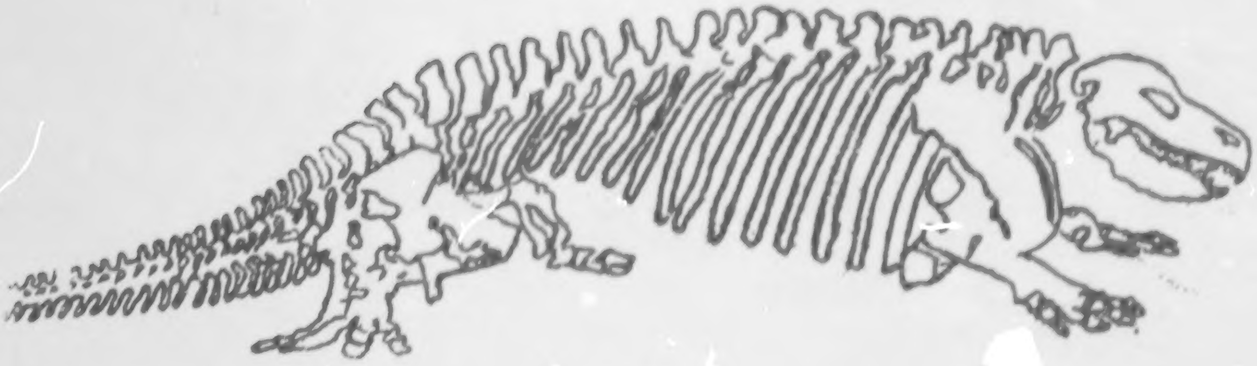


Skeleton Diagram II

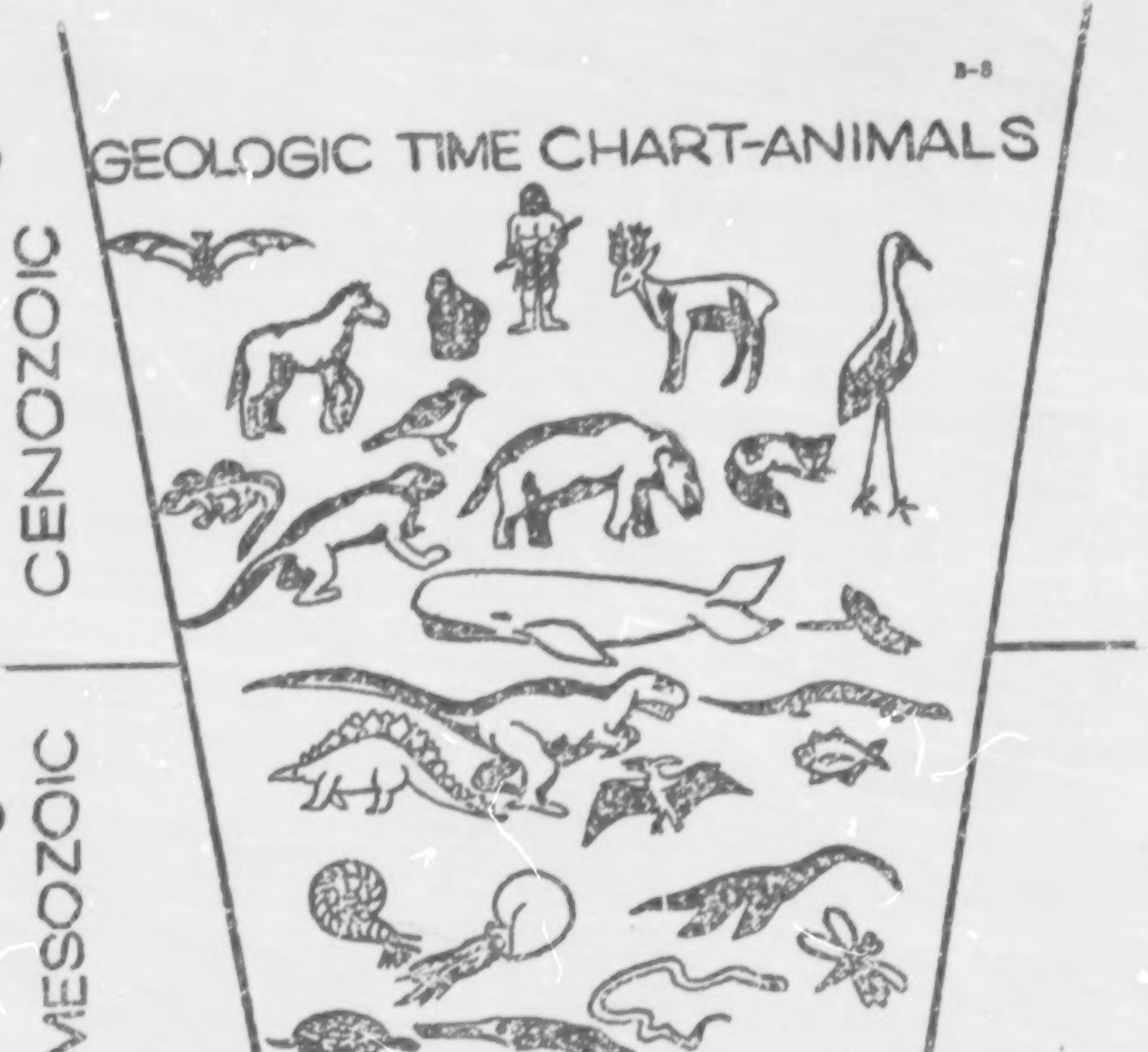


Skeleton Diagram III

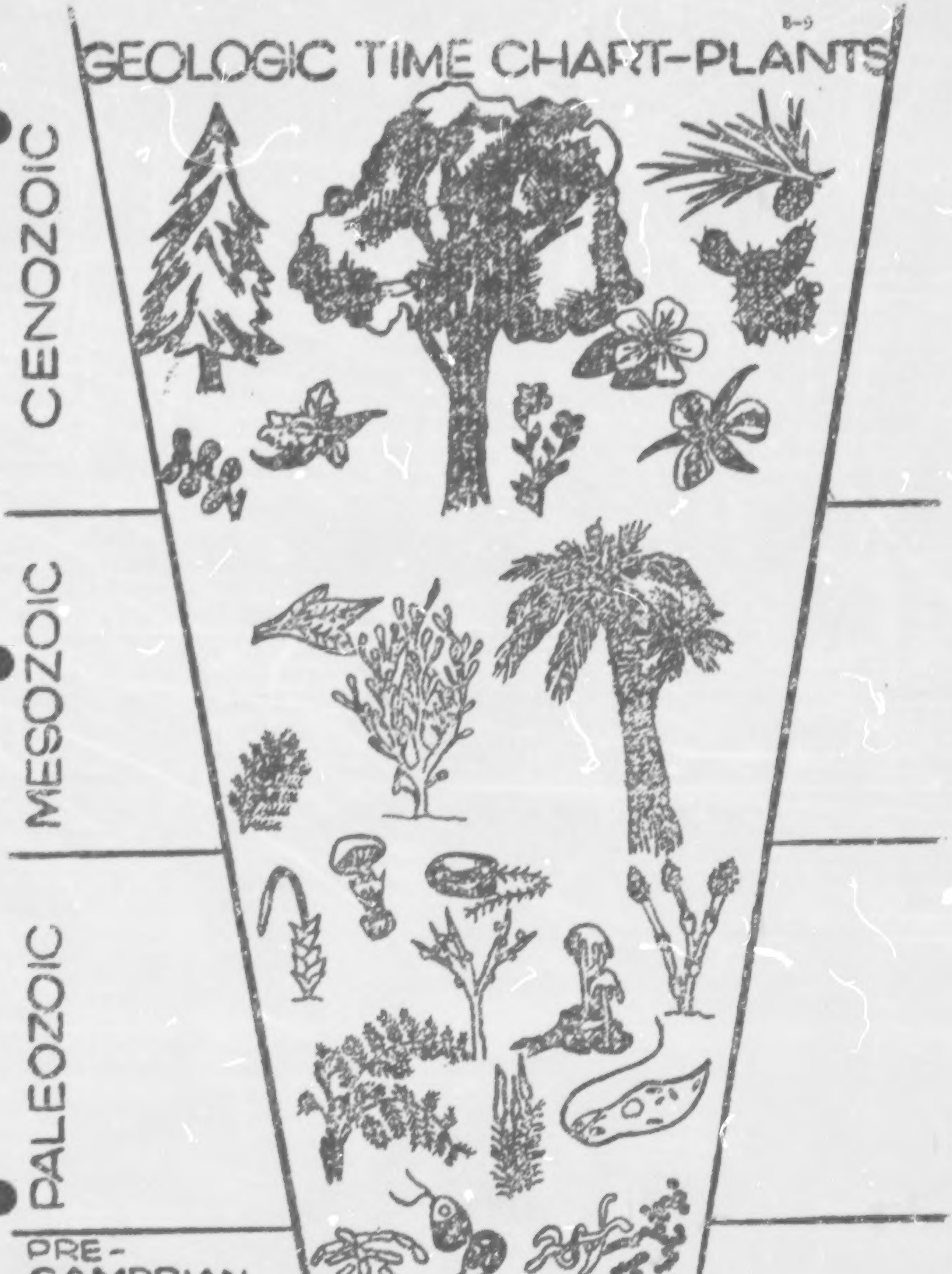


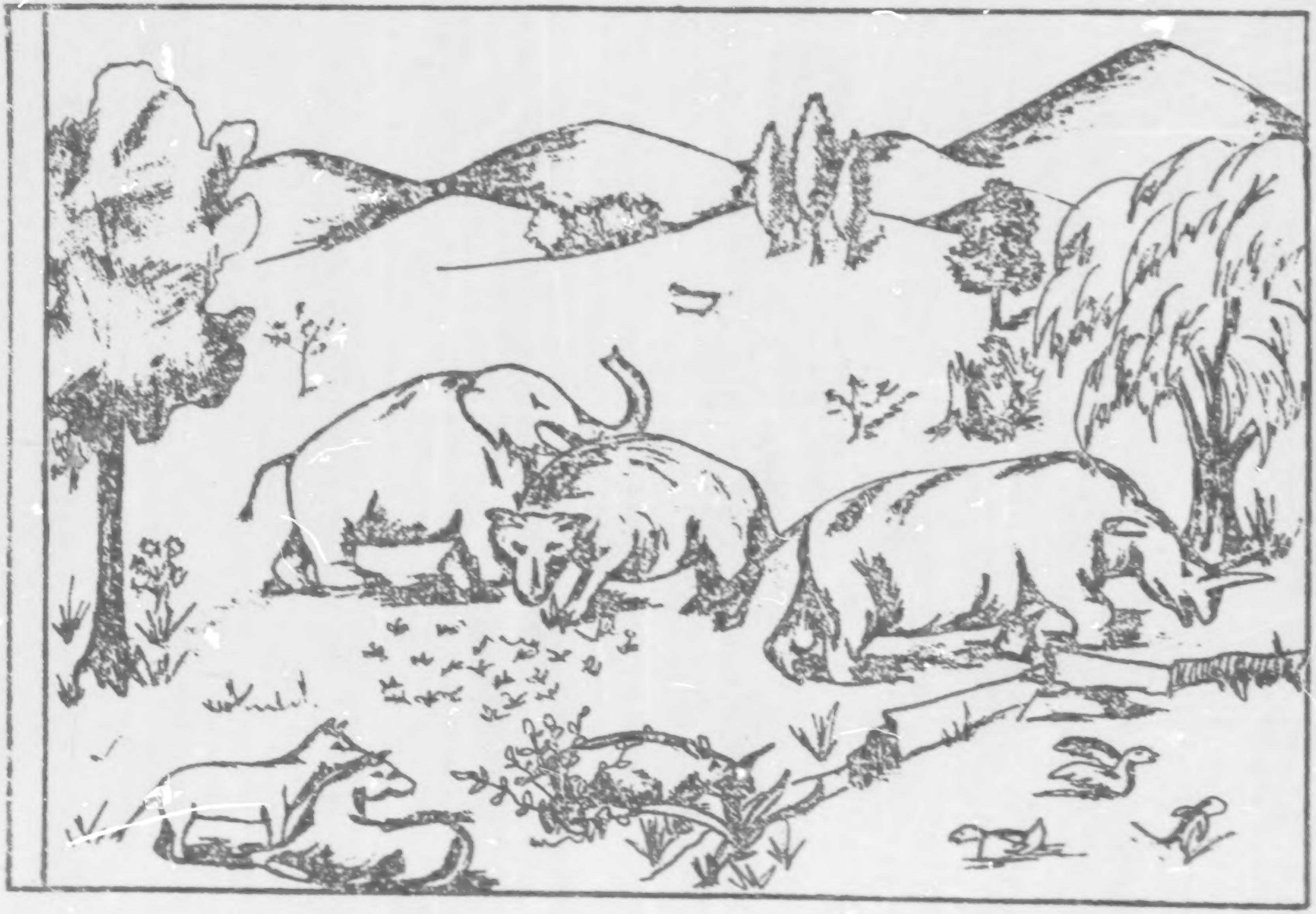


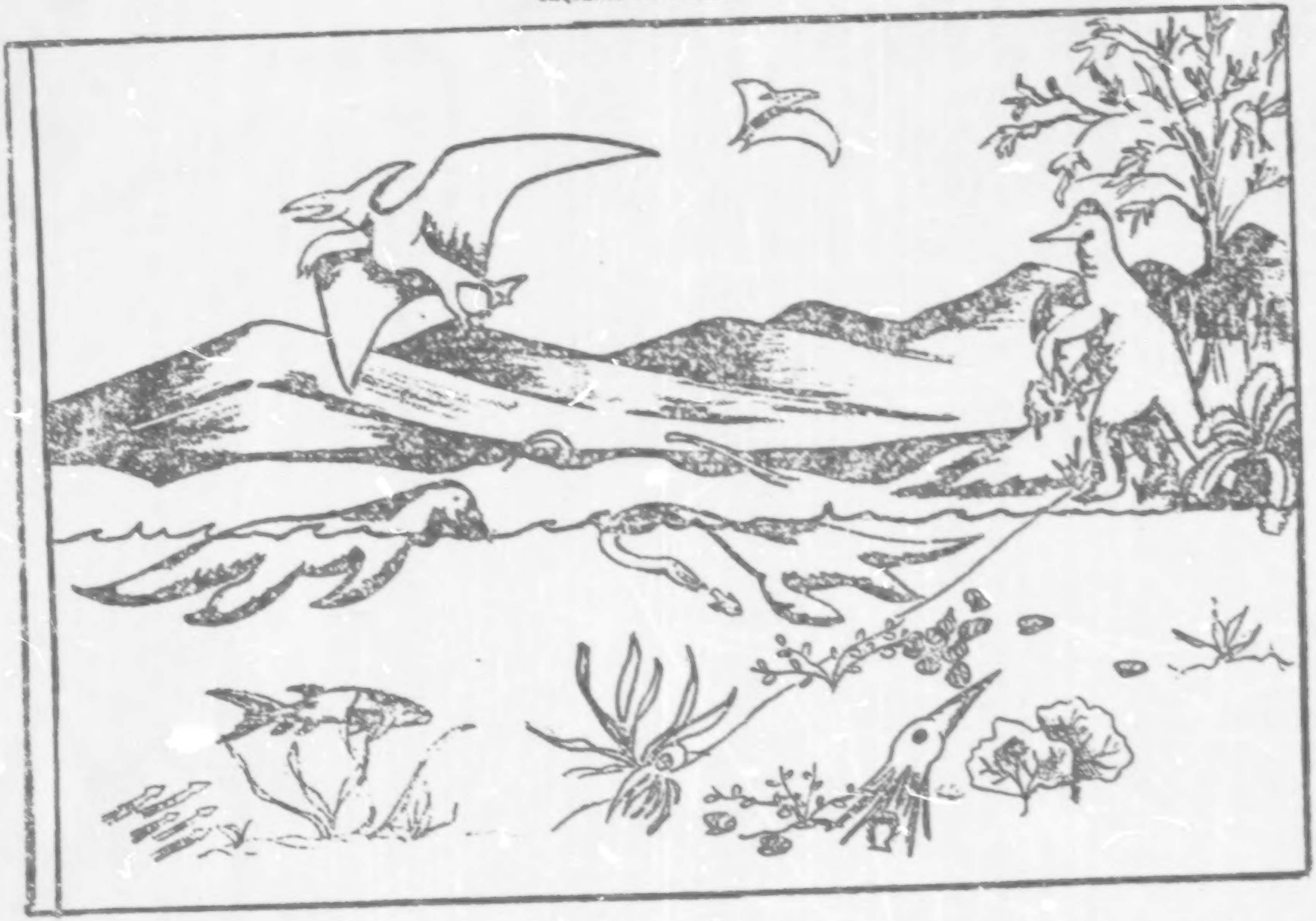
GEOLOGIC TIME CHART-ANIMALS

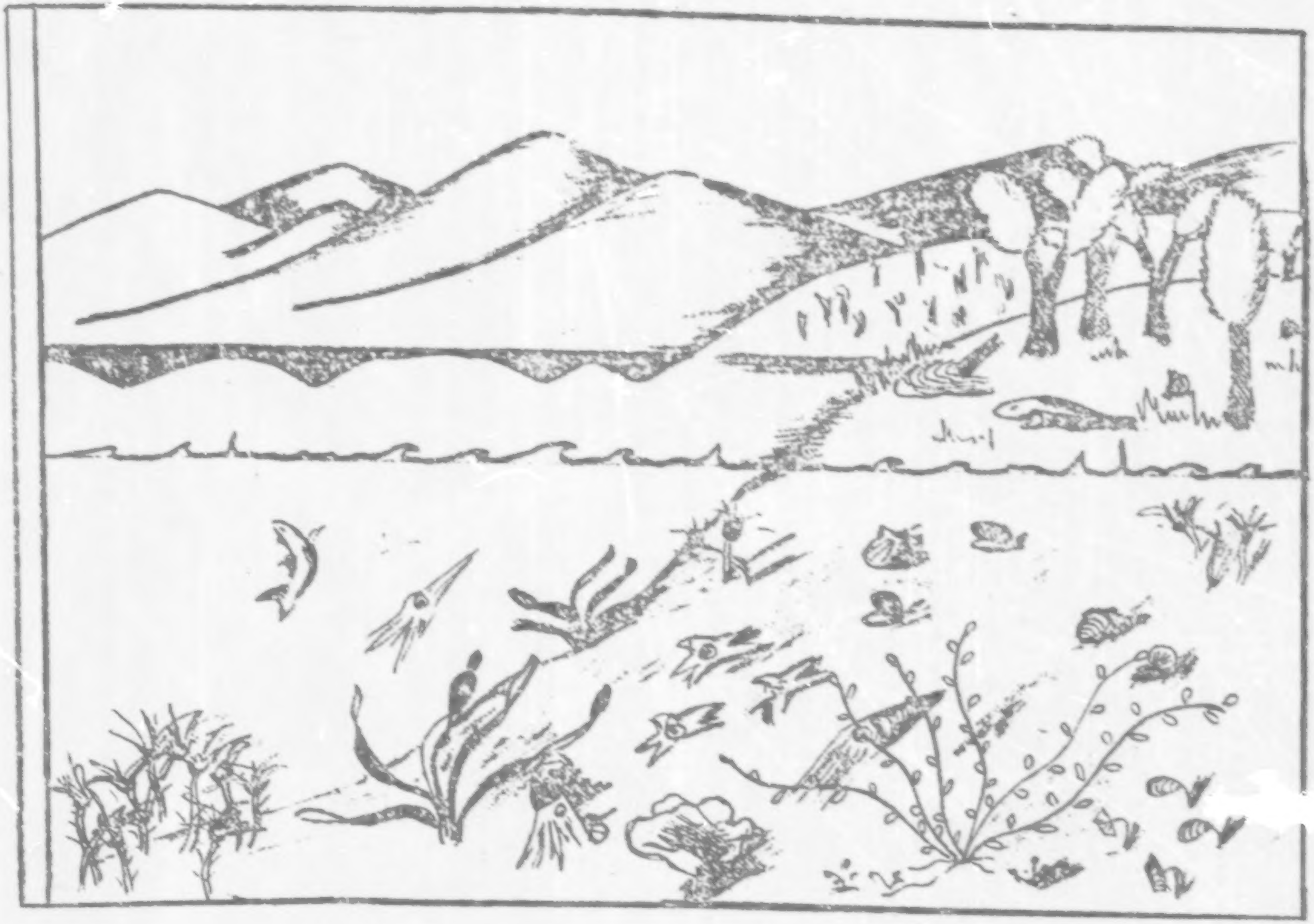

CENOZOIC
MESOZOIC
PALEOZOIC
PRE-
CAMBRIAN

GEOLOGIC TIME CHART-PLANTS


CENOZOIC
MESOZOIC
PALEOZOIC
PRE-
CAMBRIAN



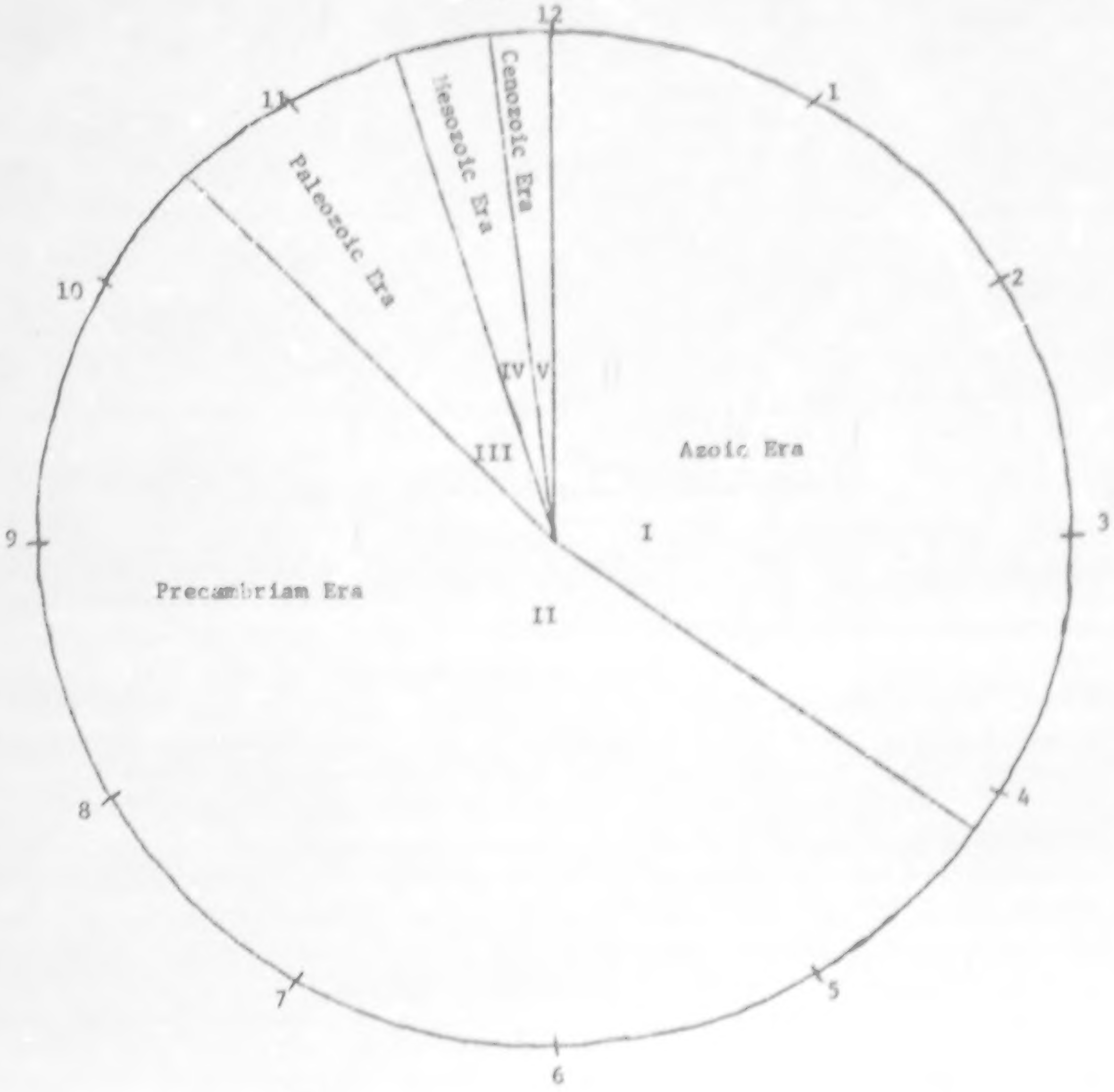




GEOLOGICAL TIME TABLE

Era	Period	Million Years Ago	Condition and Form	Plant Life	Animal Life
Cenozoic	Quarternary	½	Present conditions.	Present plant types.	Rise of civilization, man appeared.
	Tertiary	60	Formation of present mountain range. Alternate cool and warm.	Most modern flowers were present.	Elephants, apes, and horses appear. Mammals became common. Modern insects.
Mesozoic	Cretaceous	120	Some mt. building last and greatest spread of seas. Warm and moist.	Flowering plants appeared.	Dinosaurs gone.
	Juressic	150	Warm and dry. Shale, limestone, coal deposited.	Fern and cone bearing trees.	Many reptiles present. First birds appeared. Some mammals.
	Triassic	180	Warm and dry.	Cone bearing and fern like trees common.	First dinosaurs and mammals.
Paleozoic	Permian	210	Cool and dry climate. Mts. and deserts common.	Cone bearing and fern like trees.	Many strange reptiles. Trilobites disappeared.
	Pennsylvanian	250	Swamplike conditions.	First cone bearing trees. Vast swamp. Forest that formed coal deposits.	First reptiles. First insects.
	Mississippian	300	Warm and moist climate. Some mountain building.	Plants wide spread.	Great development of sharks and crinoids.
	Devonian	350	Warm climate. Seas drying up.	Mostly mosses, ferns, and fungi. First forest-tree like ferns.	First amphibians.
	Siluion	330	Mild clumate. Land still largely covered by seas.	First land plants	(Scorpions) First air-breathing animals.
	Ordovician	450	Warm climate. Land largely covered by seas.	Sea weeds.	First fish. Many animals without a backbone. Squid and octopus.
	Cambrian	550	Warm Climate. Narrow Seas.	Variety of algae in the seas.	Trilobites common. Life only in oceans.
Pre-Cambrian	Upper Pre-Cambrian	900	Earth somewhat in the present form.	Simple and shell forming algae.	Only soft forms like jellyfish and worms.
	Lower Pre-Cambrian	3,000	Earth developed seas and became surrounded by air.	Bacteria and simple algae.	One-celled or very simple like bacteria.
Azoic		4,000	Earth enlarged to nearly present size. Earth cooling. Earth's formation.	No life.	No life.

EARTH CLOCK*

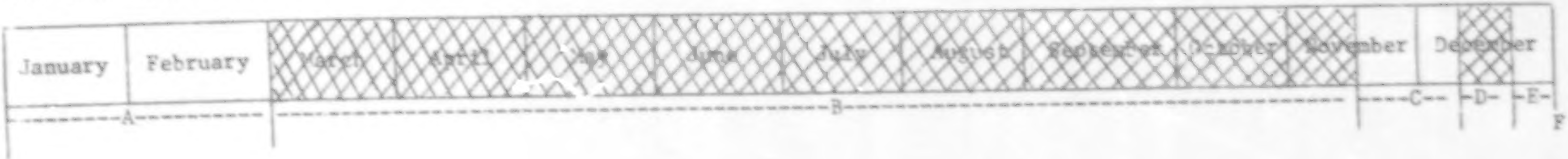

12
1
2
3
4
5
6
7
8
9
10
11
Cenozoic Era
Mesozoic Era
Paleozoic Era
Azoic Era
Precambriam Era
I
II
III
IV
V

*Each three hours represents one billion years of the earth's existence. The earth is approximately four billion years old.

4:15 - First air and water present
10:30 - Very simple plants and animals present
10:45 - First fish present
11:15 - First Amphibians present
11:20 - First reptiles
11:30 - First mammals
11:40 - First birds
12:00 - Man appeared

EARTH CALENDAR

Let one year represent the approximately 4 billion years of the Earth's existence. Each 3 months then equals 1 billion years. From January through September (3 billion years), great geological events were molding the Earth's surface. By early October, chemical conditions existed that may have made life possible. By Nov. 15 there was abundant life in the warm seas. By Dec. 15, dinosaurs dominated. By Christmas, they were gone and furry animals were present. Man came on the scene late on New Year's Eve.



A. AZOIC ERA

This era started January 1, with the forming of the earth. The earth constantly increased in size until nearly the present size. The earth experienced great temperature changes before cooling enough so that air could collect on its surface.

B. PRE-CAMBRIUM ERA

This era starts about March 1, and continues until around November 15. The earth was undergoing many changes, such as earthquakes, volcanoes, mountain formations, sea formations, and atmosphere formations. Simple forms of life must have been present by the end of the pre-cambrium era.

C. PALEOZOIC ERA (Early)

This era began about November 15, and lasted until December 12. Trilobites, early fishes, the first plants, insects, amphibians made up most of the earth's population. Calhoun Bluffs, the oldest formation in Kansas, was formed during the Pennsylvanian period of this era. Earlier Kansas had been covered by sea, raised, eroded, covered again through many cycles. During the Pennsylvanian period, Kansas was covered first by salt sea, then fresh water, then sea again of salt, etc. Different layers of rocks resulted, and coal resulted from fresh water swamps.

D. MESOZOIC ERA (Middle)

This era began about December 12, and lasted until December 21. It was known as the Age of Reptiles. Dinosaurs roamed among the early flowering plants, and birds first flew. Rocks in western Kansas were formed. Much erosion occurred. After two periods of being above sea level, the sea returned. Fossils of sea serpents, fish, and flying reptiles can be found in western Kansas.

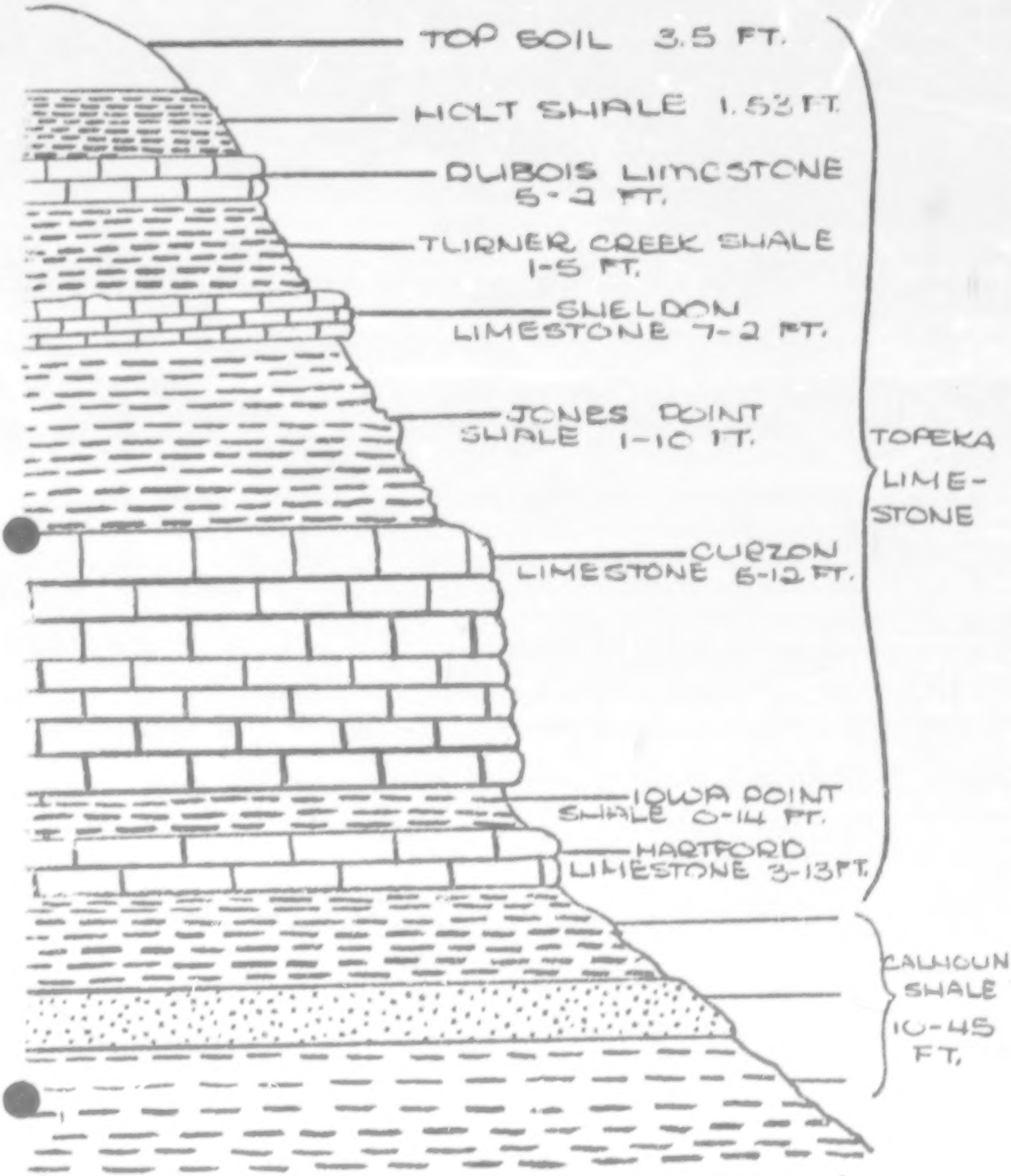
E. CENOZOIC ERA (Recent)

This time began about December 21, and continues until present day. The great dinosaurs died out, and mammals began to dominate the earth, gradually becoming the camels, horses, apes, and elephants of today. Then, at last, early man appeared. Rocky Mountains arose during this era. Rivers depositing sand and gravel formed high plains of western Kansas. Four polar ice sheets moved down 10 to 11 thousand years ago. The second ice sheet left rock masses, many containing rose quartzite. This was the only ice sheet that moved into Kansas.

F. MAN

Man, a newcomer by geological standards, would be represented by a very thin line at the end of December 31.

THE TOPEKA LIMESTONE AND CALHOUN SHALE OF THE SHAWNEE GROUP AT CALHOUN BLUFFS


TOP SOIL 3.5 FT.
HOLT SHALE 1.53 FT.
DUBOIS LIMESTONE 5-2 FT.
TURNER CREEK SHALE 1-5 FT.
SHELDON LIMESTONE 7-2 FT.
JONES POINT SHALE 1-10 FT.
CURZON LIMESTONE 5-12 FT.
IOWA POINT SHALE 0-14 FT.
HARTFORD LIMESTONE 3-13 FT.
TOPEKA LIME-STONE
CALHOUN SHALE 10-45 FT.

This diagram shows the members of the Topeka Formation and Calhoun Formations as you would see them when stopping at the road cut through the Calhoun Bluffs east of Topeka.

APPENDIX C

Plants and Animals

The items in Appendix C are designed for use with the content of Topic II, Plants and Animals. Topic II contains suggestions of ways to use each of the items. Teachers should feel free to modify the materials or usage to best suit their classes.

Living and Nonliving Things C-1

Water Cycle Picture C-2

Oxygen - Carbon Dioxide Relationship C-3

Plant Life Cycle C-4

Animal Life Cycles C-6

Food Web Pictures C-7

Variation and Similarity Pictures C-9

Pond Succession C-13

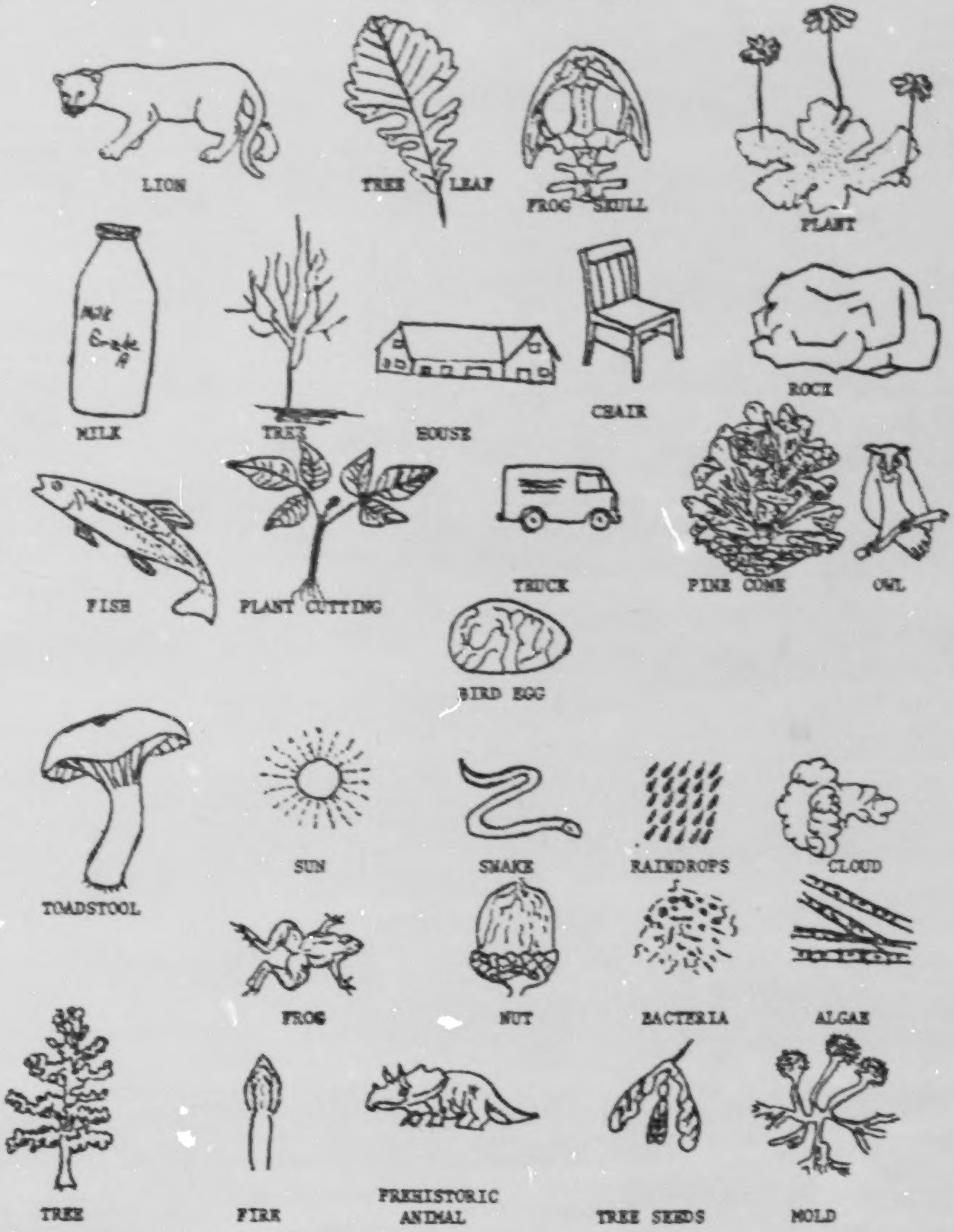
Plant and Animal Adaptations C-14

Man and His Environment C-20

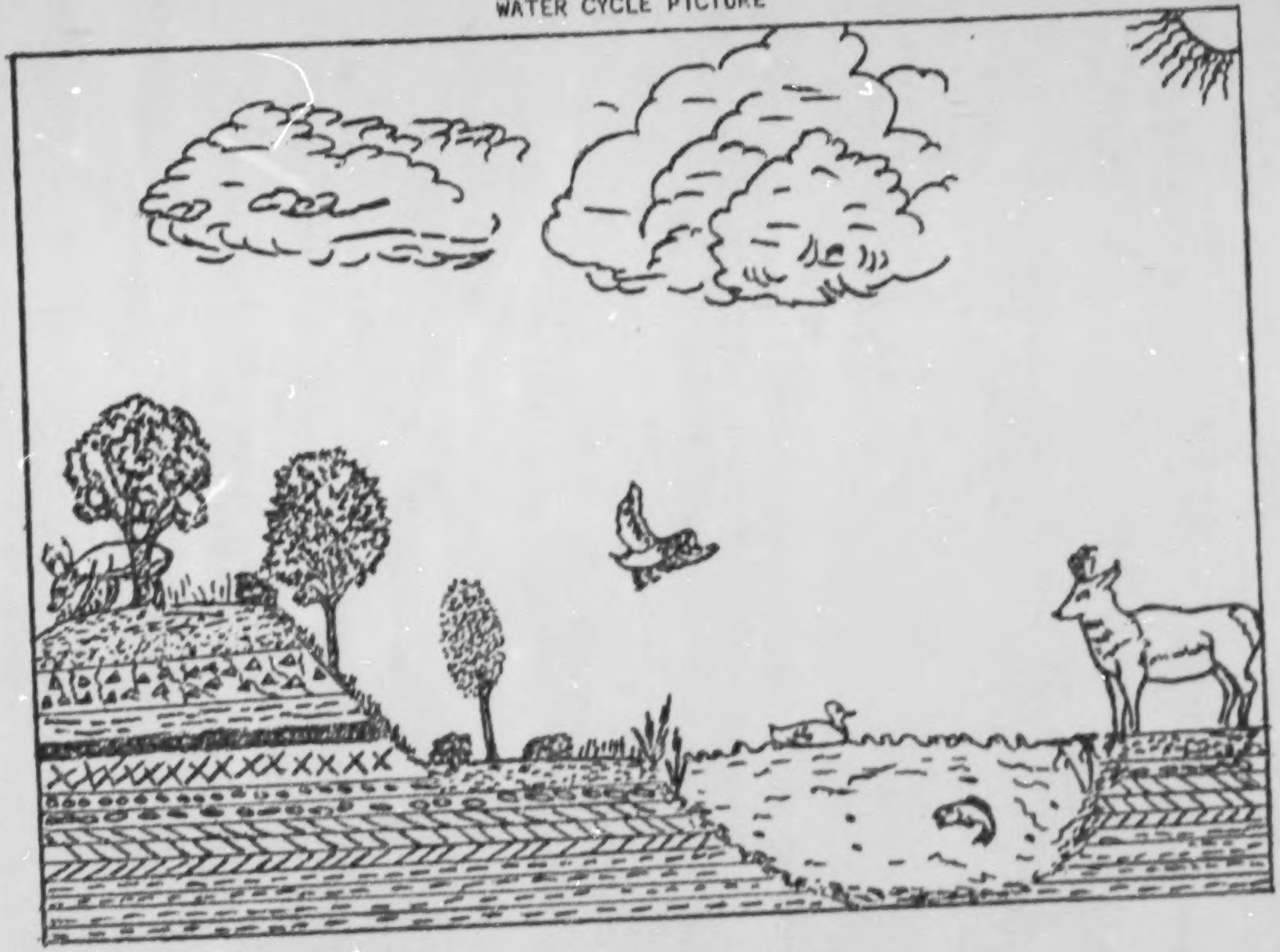
Directions for Establishing and Maintaining Plants and Animals
in the Classroom C-21

APPENDIX C

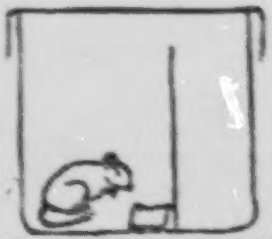
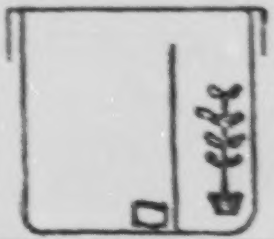
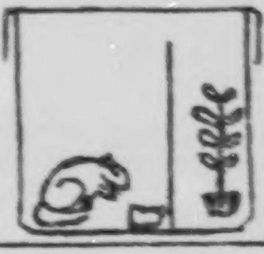
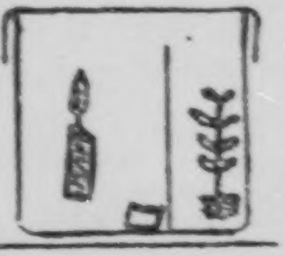
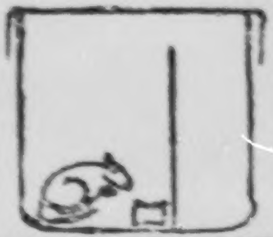
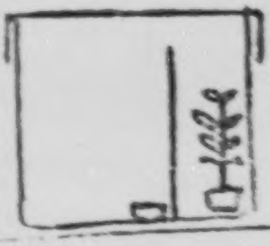
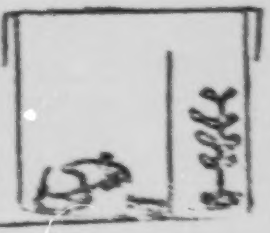
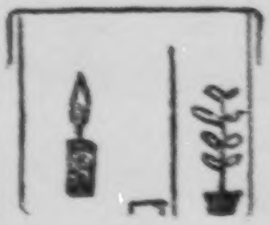
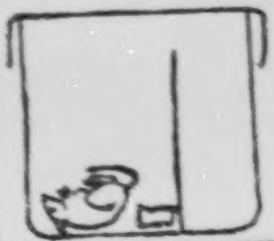
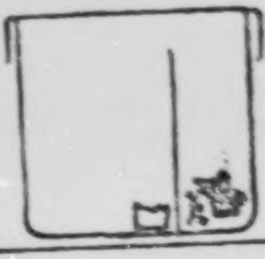
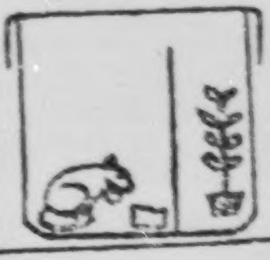
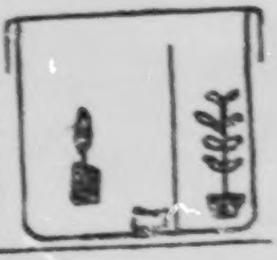
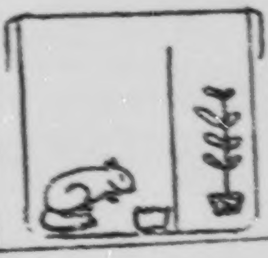
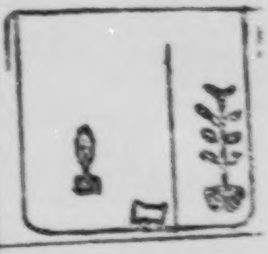
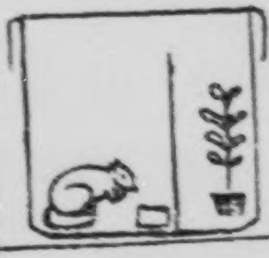
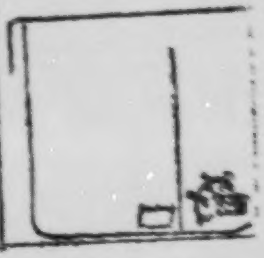
LIVING AND NONLIVING THINGS


LION
TREE LEAF
FROG SKULL
PLANT
Milk
Grade
A
MILK
TREE
HOUSE
CHAIR
ROCK
FISH
PLANT CUTTING
TRUCK
PINE CONE
OWL
BIRD EGG
TOADSTOOL
SUN
SNAKE
RAINDROPS
CLOUD
FROG
NUT
BACTERIA
ALGAE
TREE
FIRE
PREHISTORIC ANIMAL
TREE SEEDS
MOLD

WATER CYCLE PICTURE

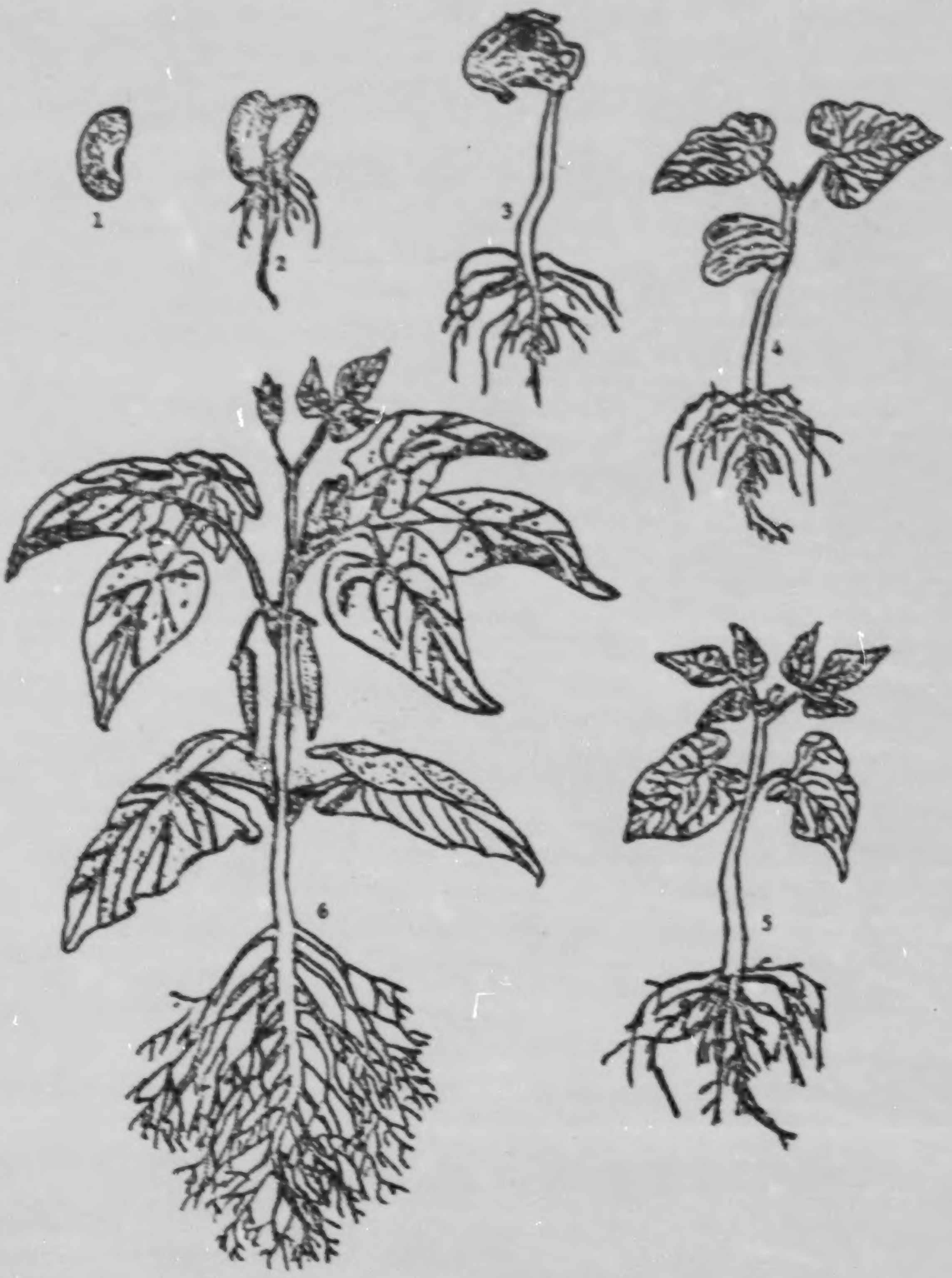


CARBON DIOXIDE-OXYGEN RELATIONSHIP

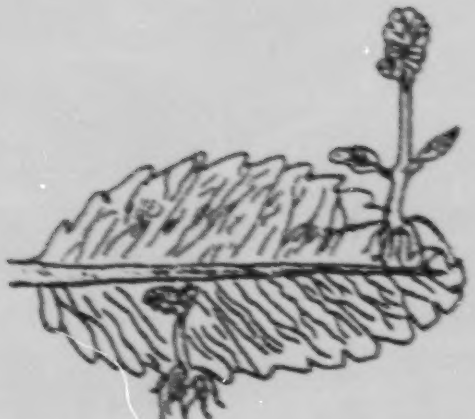
	Series I	Series II	Series III	Series IV
Starting Conditions				
24 Hours				
48 Hours				
72 Hours				
96 Hours				

APPENDIX C

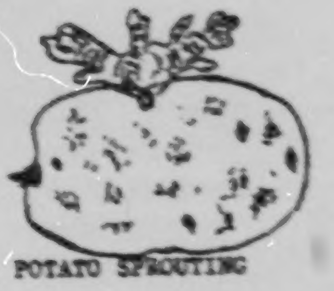
PLANT LIFE CYCLE: I



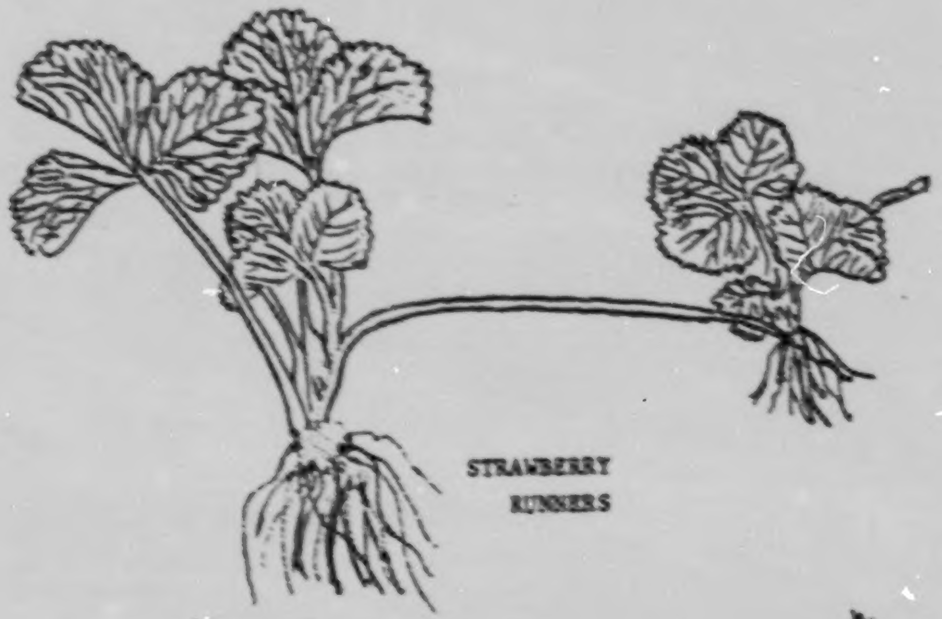
PLANT LIFE CYCLE: II



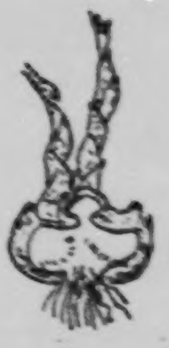
PLANTS GROWING FROM LEAF NOTCHES



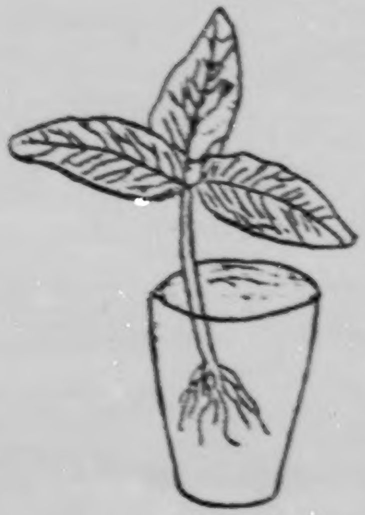
POTATO SPROUTING



STRAWBERRY
RUNNERS



BULB SPROUTING

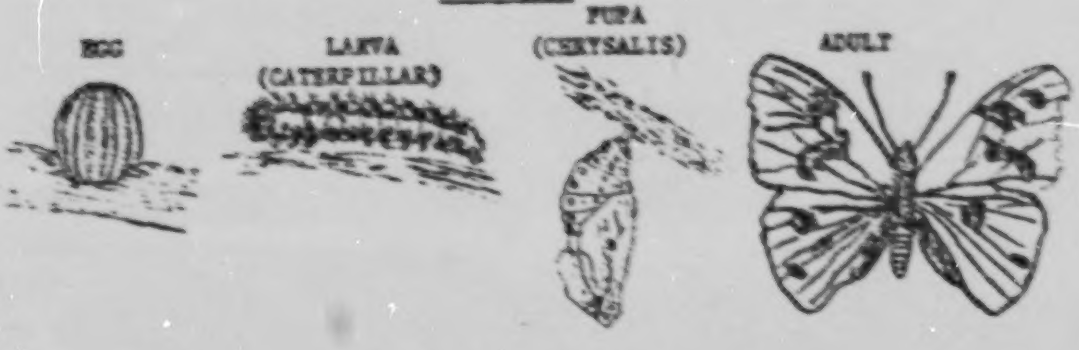


PLANT CUTTING

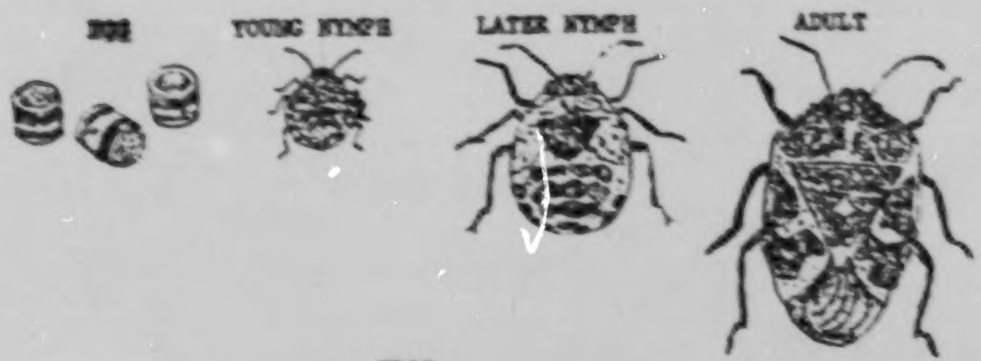
APPENDIX C

ANIMAL LIFE CYCLES

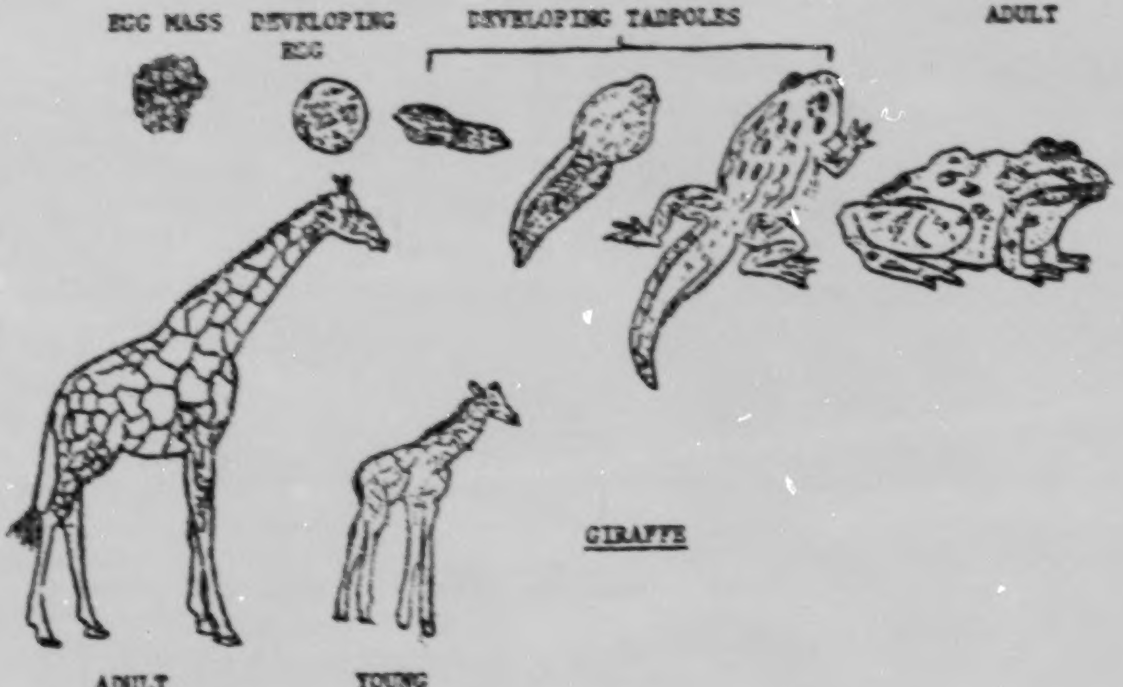
BUTTERFLY


EGG
LARVA
(CATERPILLAR)
PUPA
(CHRYSALIS)
ADULT

STINK BUG

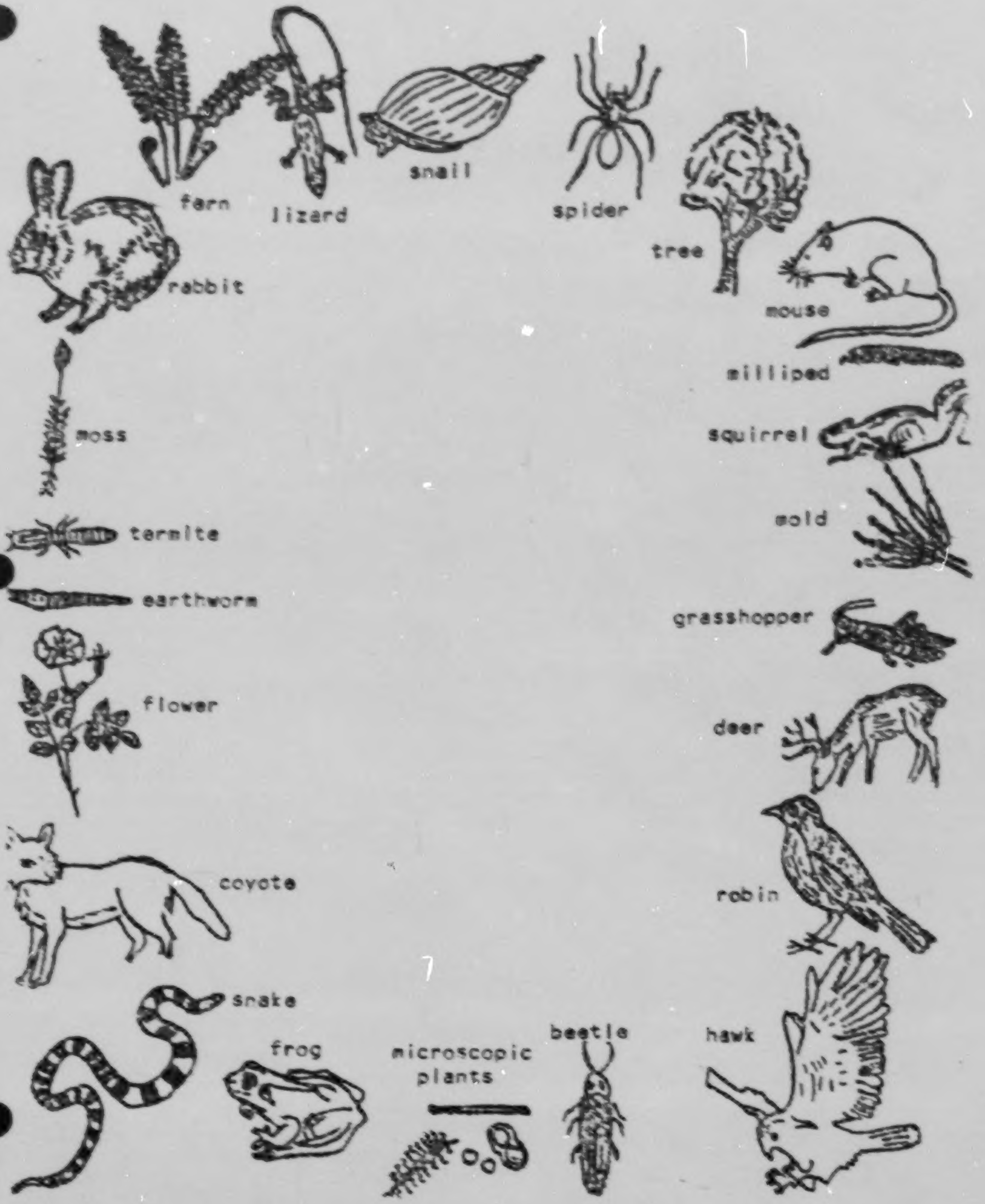

EGG
YOUNG NYMPH
LATER NYMPH
ADULT

FROG

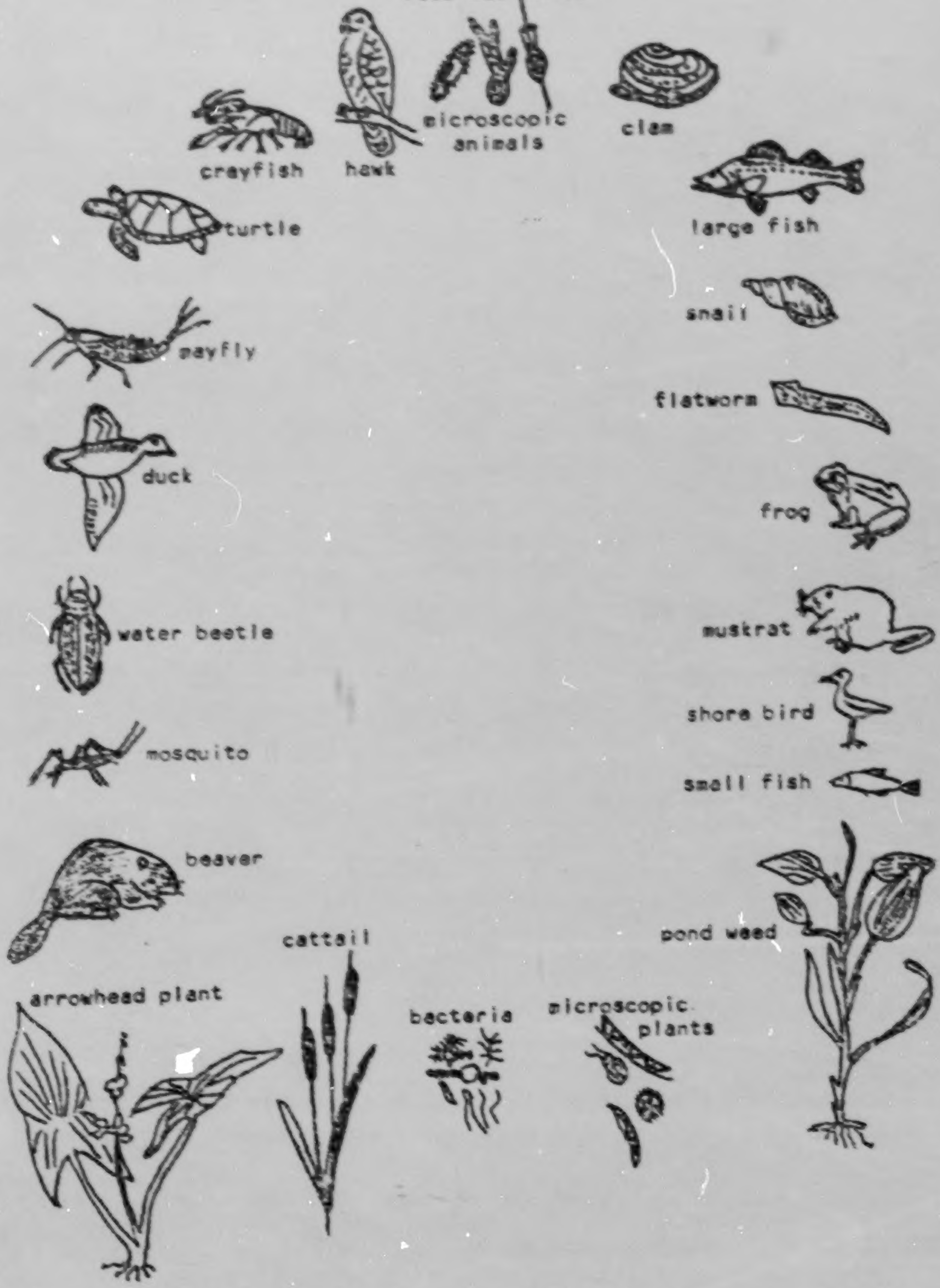

EGG MASS
DEVELOPING
EGG
DEVELOPING TADPOLES
ADULT
ADULT
YOUNG

GIRAFFE

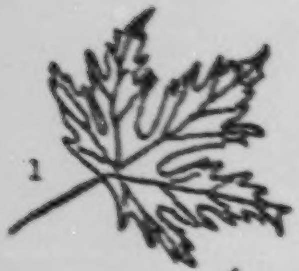
FOOD WEB -- 1


fern
lizard
snail
spider
tree
rabbit
mouse
milliped
moss
squirrel
mold
termite
earthworm
grasshopper
flower
deer
coyote
robin
snake
frog
microscopic plants
beetle
hawk

FOOD WEB -- II


crayfish
hawk
microscopic animals
clam
large fish
turtle
mayfly
snail
flatworm
duck
frog
water beetle
muskrat
shore bird
mosquito
small fish
beaver
pond weed
cattail
arrowhead plant
bacteria
microscopic plants

VARIATION AND SIMILARITY PICTURES -- I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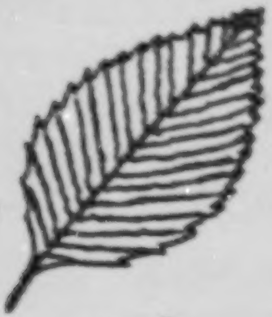
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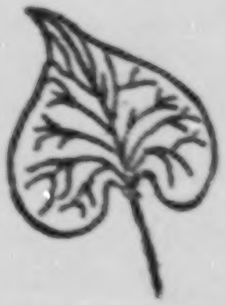
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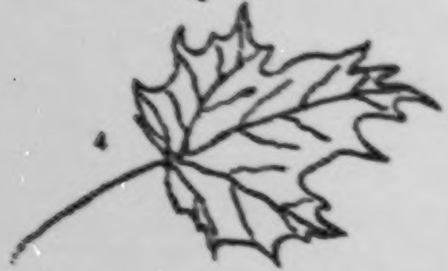
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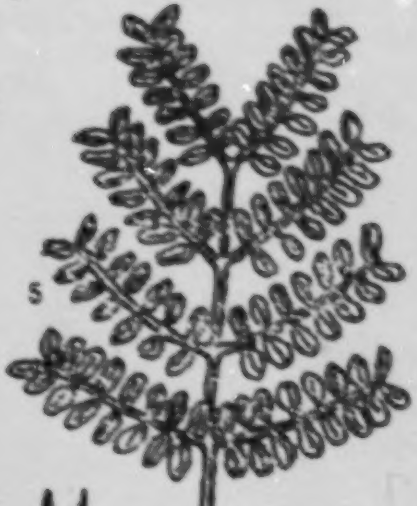
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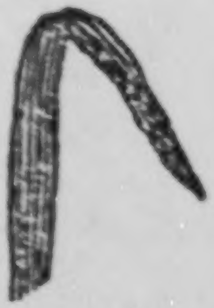
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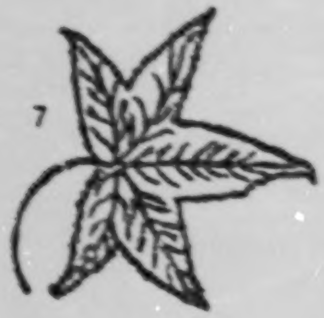
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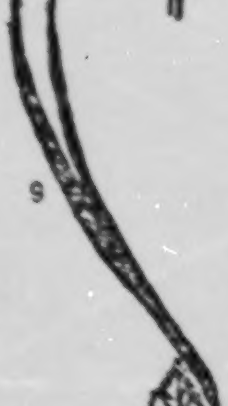
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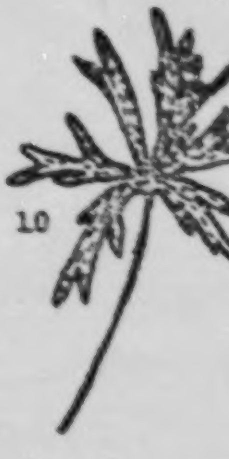
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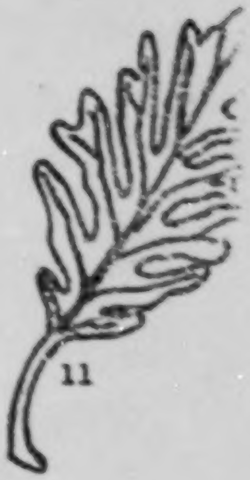
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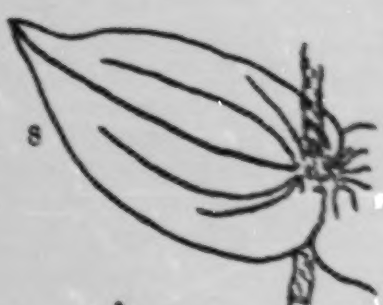
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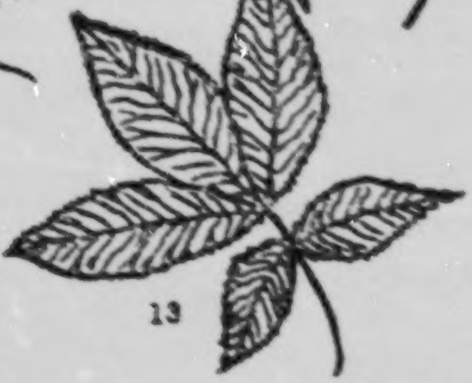
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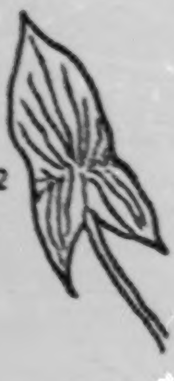
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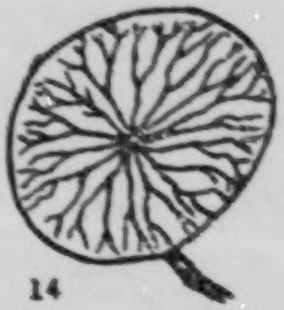
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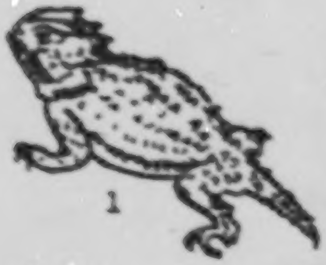
VARIATION AND SIMILARITY PICTURES -- II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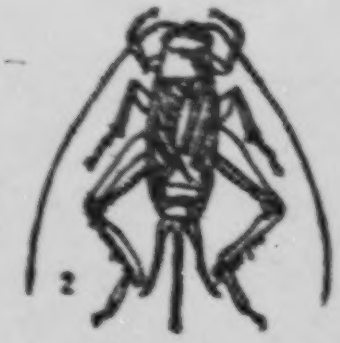
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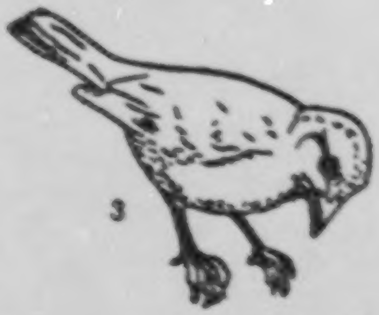
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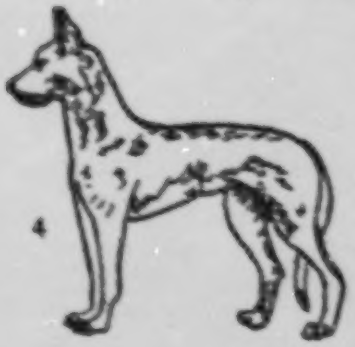
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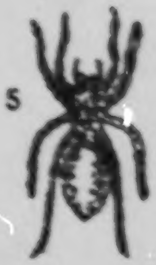
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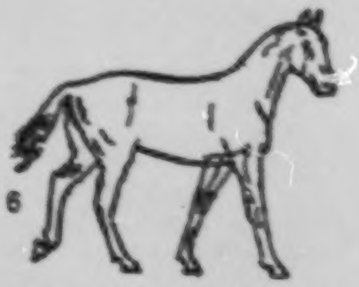
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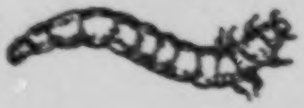
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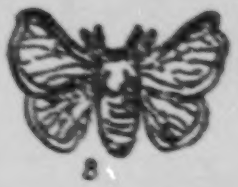
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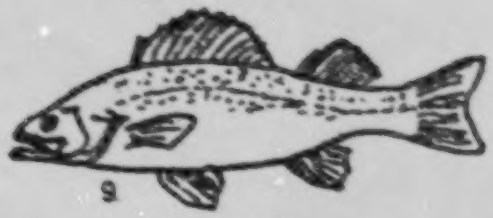
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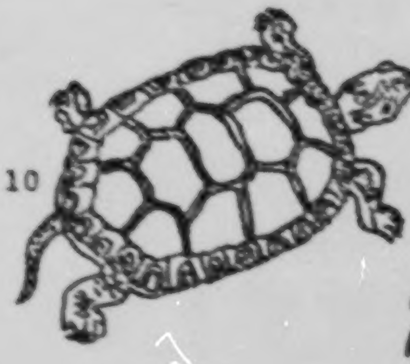
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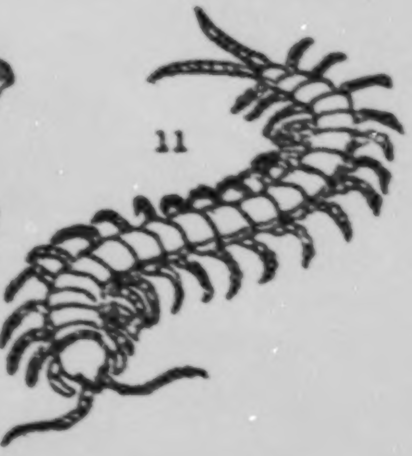
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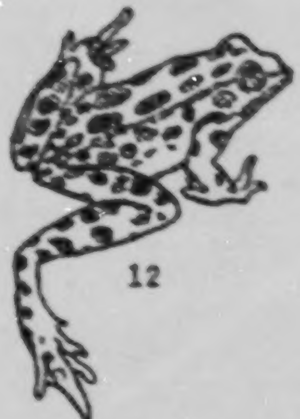
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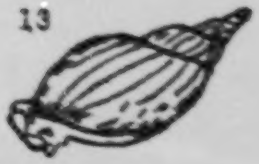
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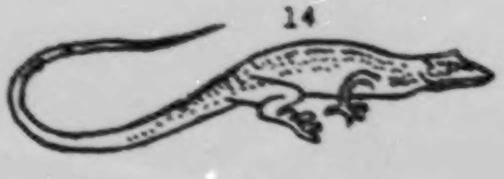
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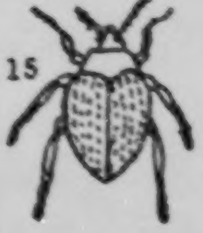
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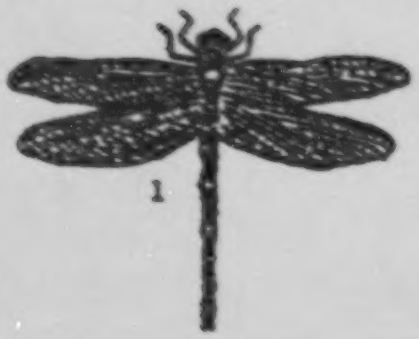
VARIATION AND SIMILARITY PICTURES -- III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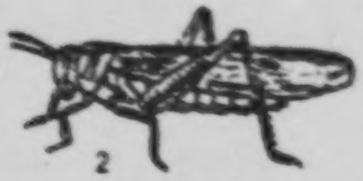
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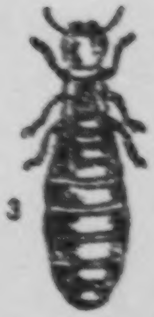
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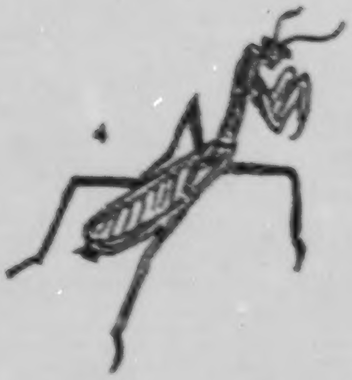
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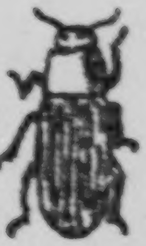
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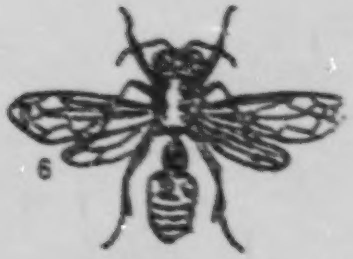
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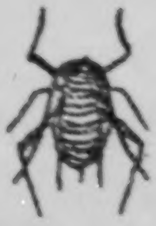
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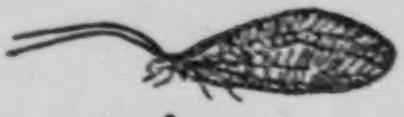
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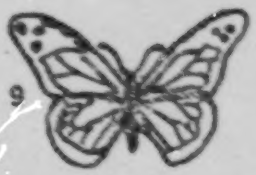
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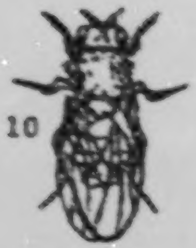
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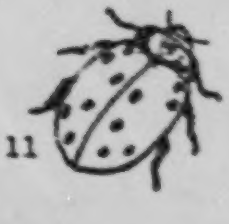
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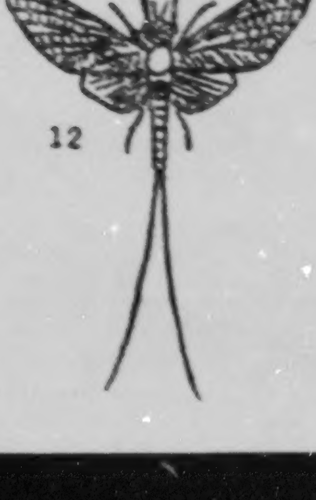
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VARIATION AND SIMILARITY PICTURES -- IV

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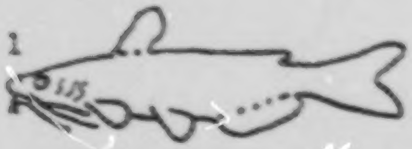

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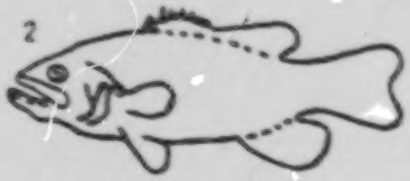

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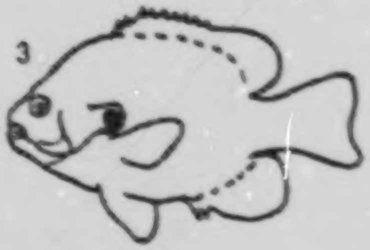

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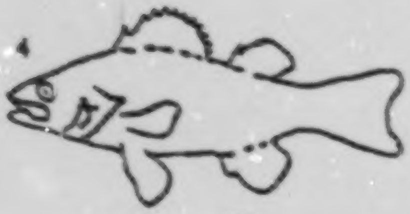

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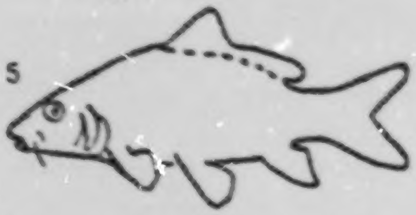

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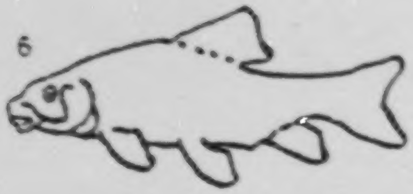

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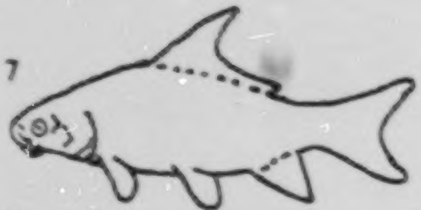

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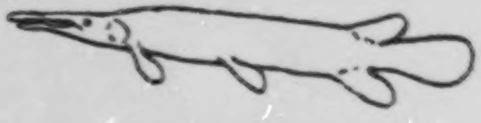

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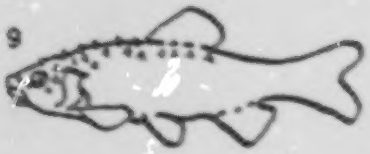

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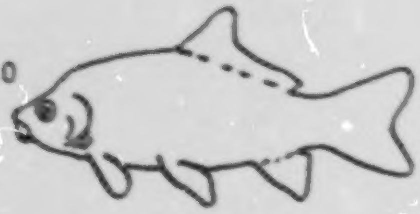

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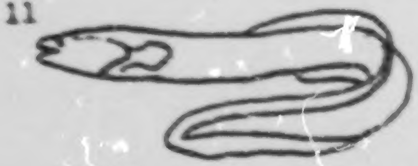

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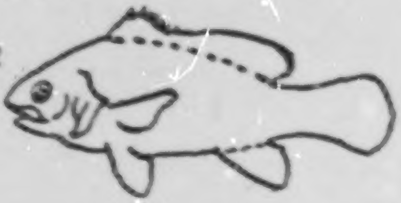

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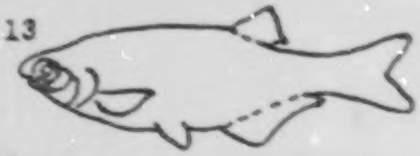

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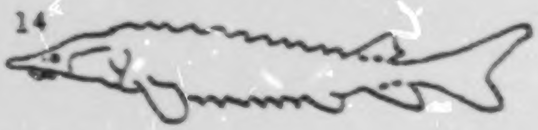

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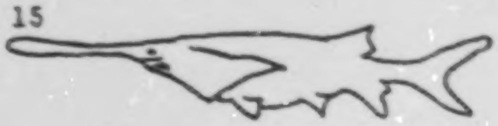

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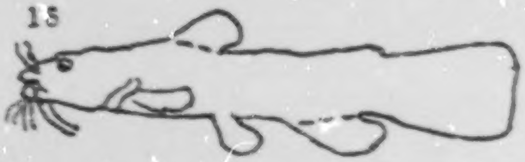
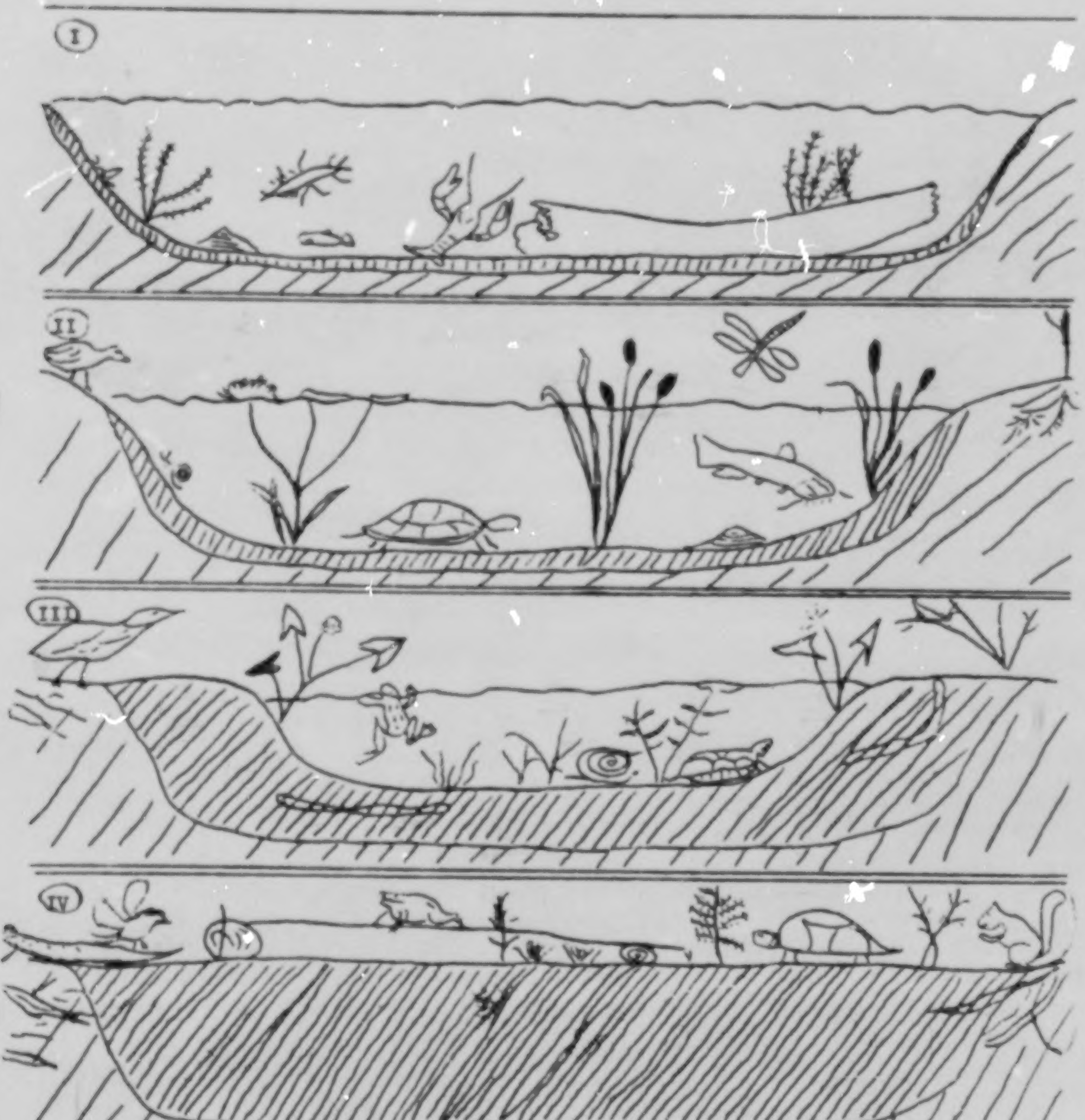
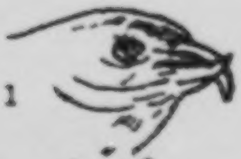


POND SUCCESSION

All living communities change with the passage of time. These drawings show the changes in the physical environment in a pond community and the effect of these changes upon the life forms in that community. As the pond fills, the plants change and new animals come into the ecosystem (2). Marshy banks (3) encourage an increase in land plants and insects as well as earthworms. The moist, humus soil of the filled pond (4) promotes tree growth that may someday be a forest.



ANIMAL ADAPTATION PICTURES -- I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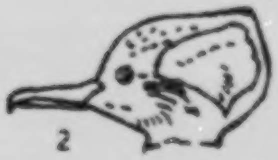
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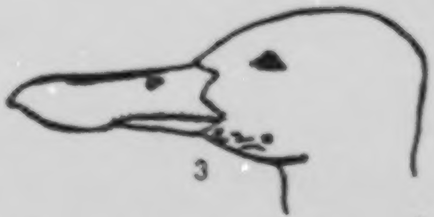
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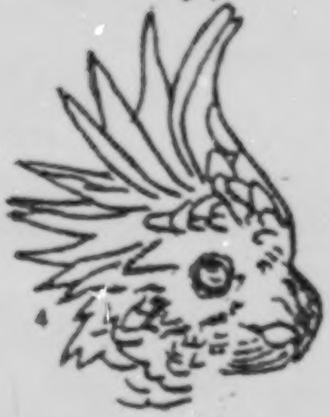
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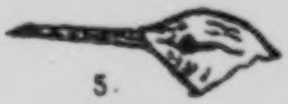
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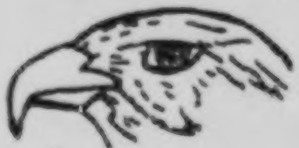
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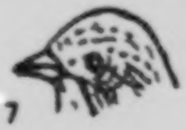
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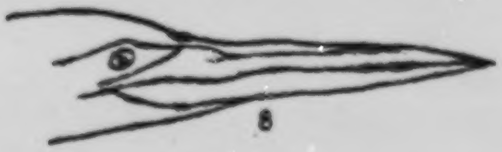
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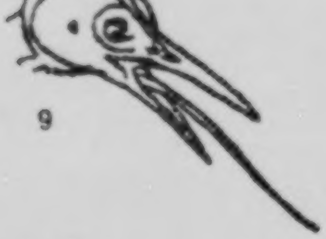
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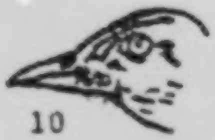
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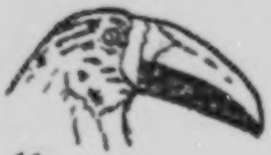
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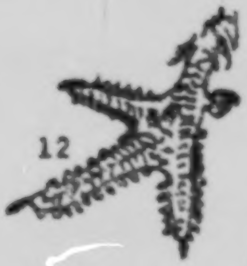
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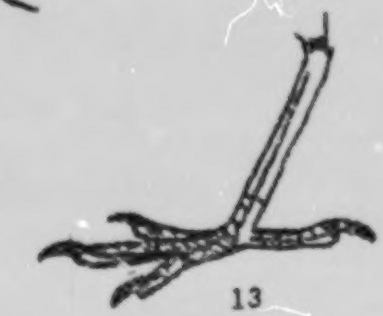
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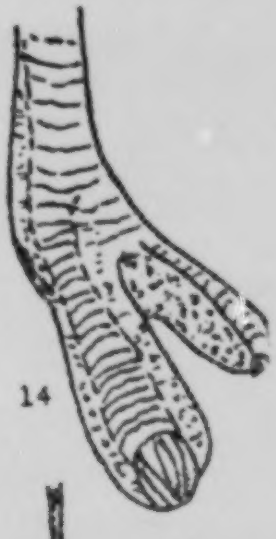
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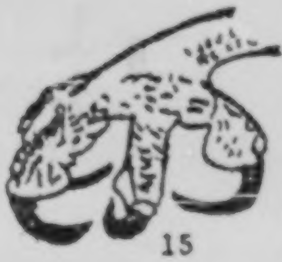
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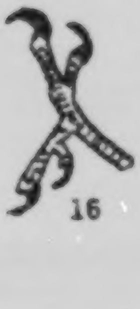
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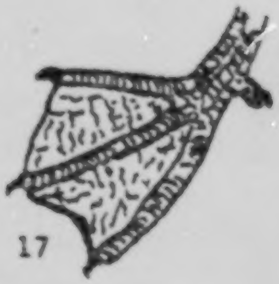
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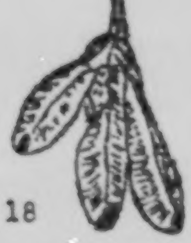
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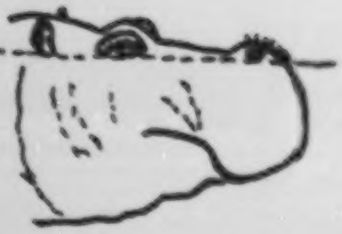
Animal Adaptation Pictures I

1. Crossbill: The crossed beaks are used as levers to pry seeds from evergreen cones.
2. Merganser: Hook on the end of the bill is used to hold fish until they can be swallowed.
3. Duck: Sieves along the sides of the bill allow water to escape from the mouth while retaining food.
4. Cockatoo: Strong hooked beak used for cracking and opening nuts.
5. Humming Bird: Long slender bill for reaching into flowers for nectar.
6. Falcon: Strong curved upper beak for capturing and tearing live animals.
7. Sparrow: Short, stout beak for cracking and eating seeds.
8. Green Heron: Narrow, pointed beak for spearing fish.
9. Woodpecker: Sharp, pointed beak for drilling into wood. Long tongue for reaching into holes for insects.
10. Horned Lark: Tufts beside the beak to help capture insects while flying.
11. Toucan: Large beak used to gather fruit.
12. Ruffed Grouse: Scaly fringe on the toes aids in walking on snow.
13. Robin: An all purpose foot.
14. Ostrich: Strong, heavy foot used for walking and running.
15. Osprey: Strong toes with heavy curved claws used in capturing live animals.
16. Woodpecker: Two toes forward and two backwards used for gripping to sides of trees.
17. Mallard Duck: Webbing between the toes aids during swimming.
18. Horned Grebe: Paddle shaped toes act as boat paddles during swimming.

ANIMAL ADAPTATION PICTURES -- II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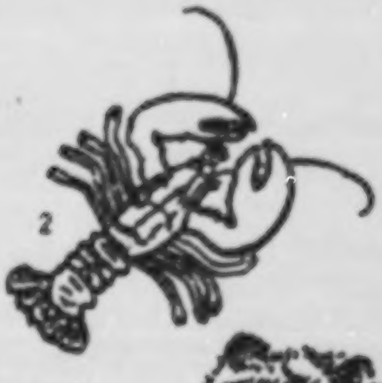
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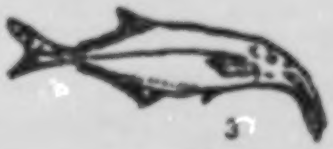
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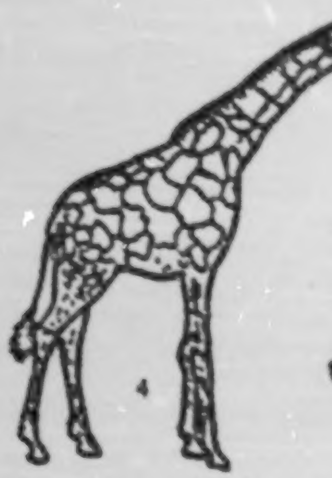
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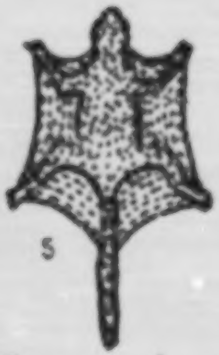
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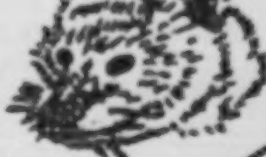
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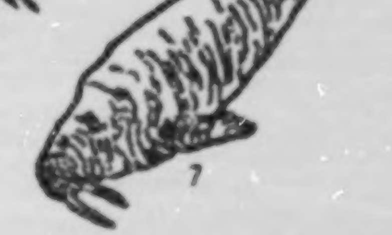
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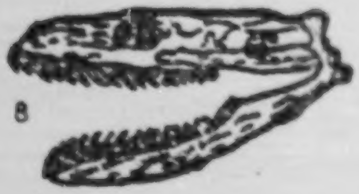
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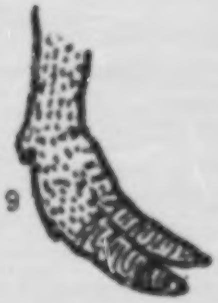
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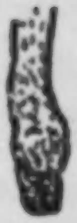
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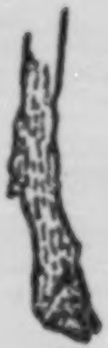
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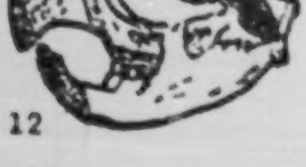
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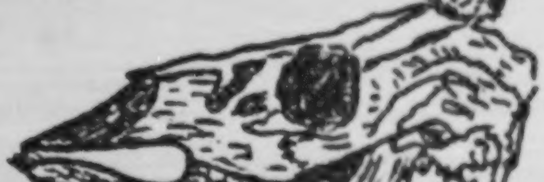
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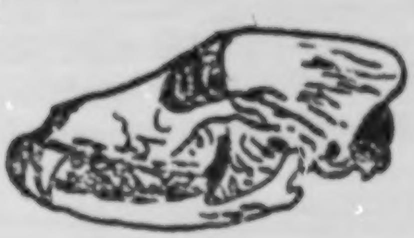
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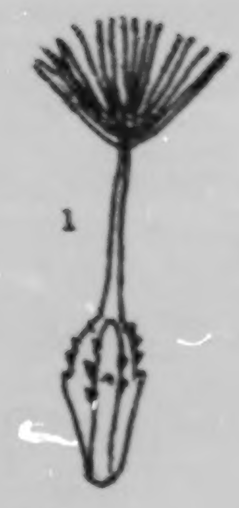
Animal Adaptation Pictures II

1. Hippopotamus: Well adapted for remaining hidden in water. The eyes, ears, and nose are all on the surface of the head so very little of the body needs to be exposed.
2. Crayfish: Wide tail can be used as a paddle to move quickly backwards in water. Large pinchers (claws) used for capturing live food. Long feelers helpful in locating food.
3. Elephant-snout fish: The long snout is used to feed between rocks and plants on lake or river bottom.
4. Giraffe: The long neck allows the giraffe to reach tree leaves other animals cannot. Tuffed tail is used as a fly swatter. Long legs are excellent for running.
5. Flying Squirrel: The skin joining legs, neck, and tail act as wings when the squirrel jumps and allows it to glide long distances.
6. Arctic Fox: Small ears reduce loss of body heat. Fur covering the face conserves the body heat.
7. Arctic Walrus: The two large tusks are used in digging clams.
8. Snake Skull: All the teeth slanting backwards helps hold live animals until they can be swallowed.
9. Sitatunga (Antelope): The large banana shaped feet help walk on soft marsh or swampy surface.
10. South African Klipspringer (Antelope): Very small feet are well adapted for mountain climbing and holding onto rock ledges.
11. Gerenuk (Antelope): Front feet adapted for holding onto tree branches while eating leaves.
12. Beaver Skull: Front teeth (incisors) well adapted for cutting wood. No need for tearing teeth as they do not eat other animals.
13. Deer Skull: Front teeth (incisors) used to gather grass and shrubs. Back teeth (molars) used to grind or chew the plants.
14. Dog Skull: The long pointed teeth (canines) are used for capturing and holding live animals.

PLANT ADAPTATION PICTURES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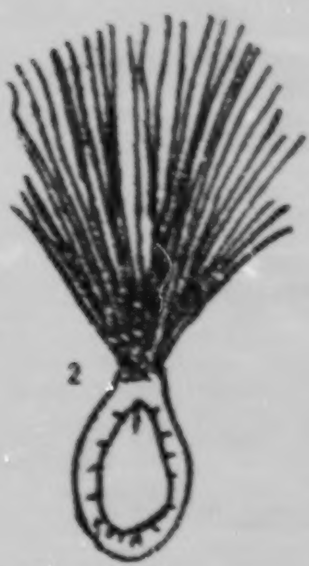
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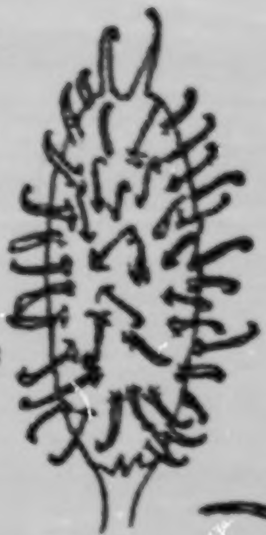
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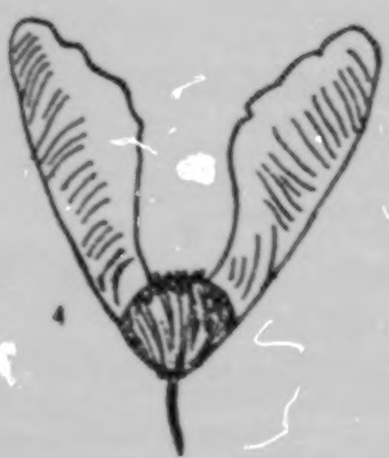
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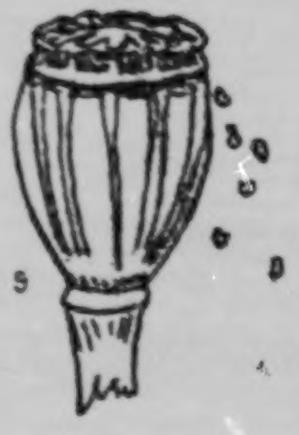
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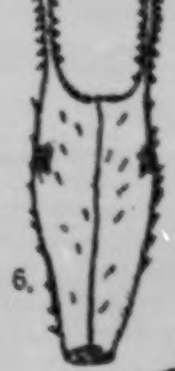
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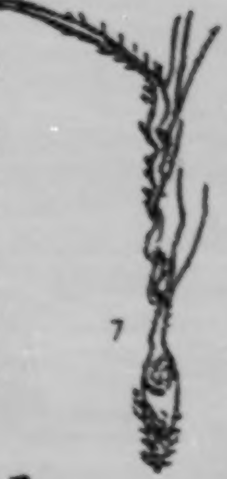
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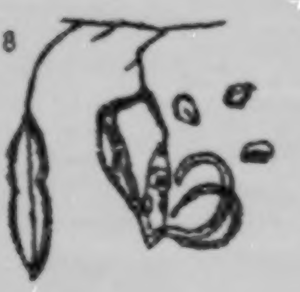
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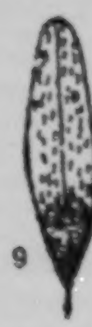
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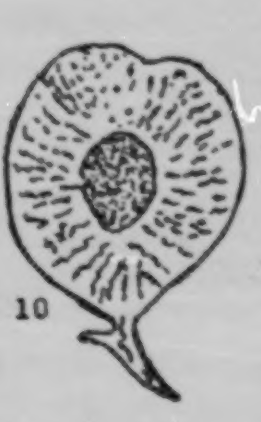
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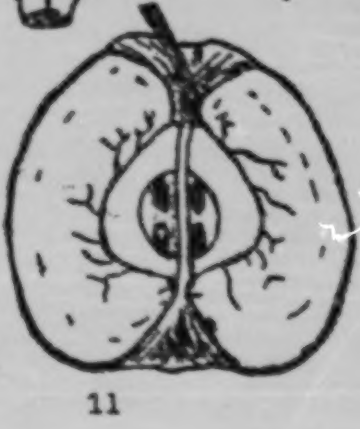
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Plant Adaptation Pictures

1. Dandelion Seed: Seed contains an umbrella which allows the wind to carry the seed away from the parent plant.

2. Milkweed Seed: Seed contains an umbrella which allows the wind to carry the seed away from the parent plant.

3. Cocklebur Seed: Hooks covering the seed pod attach to animal fur and clothing and are carried to new locations.

4. Maple Seed: Seed wings act like helicopter blades when the seed falls, causing it to move away from parent plant.

5. Poppy Seed Capsule: Holds open around the top of the capsule and when the capsule is shaken by wind or passing animals, the seeds are spread like pepper from a shaker.

6. Beggar Tick Seed: Barbs over the seed surface attach to animal fur or clothing and are carried to new locations.

7. Filares Seed: The seed acts like a cork screw. As the humidity changes, the tail curls up causing the seed to screw itself into the ground.

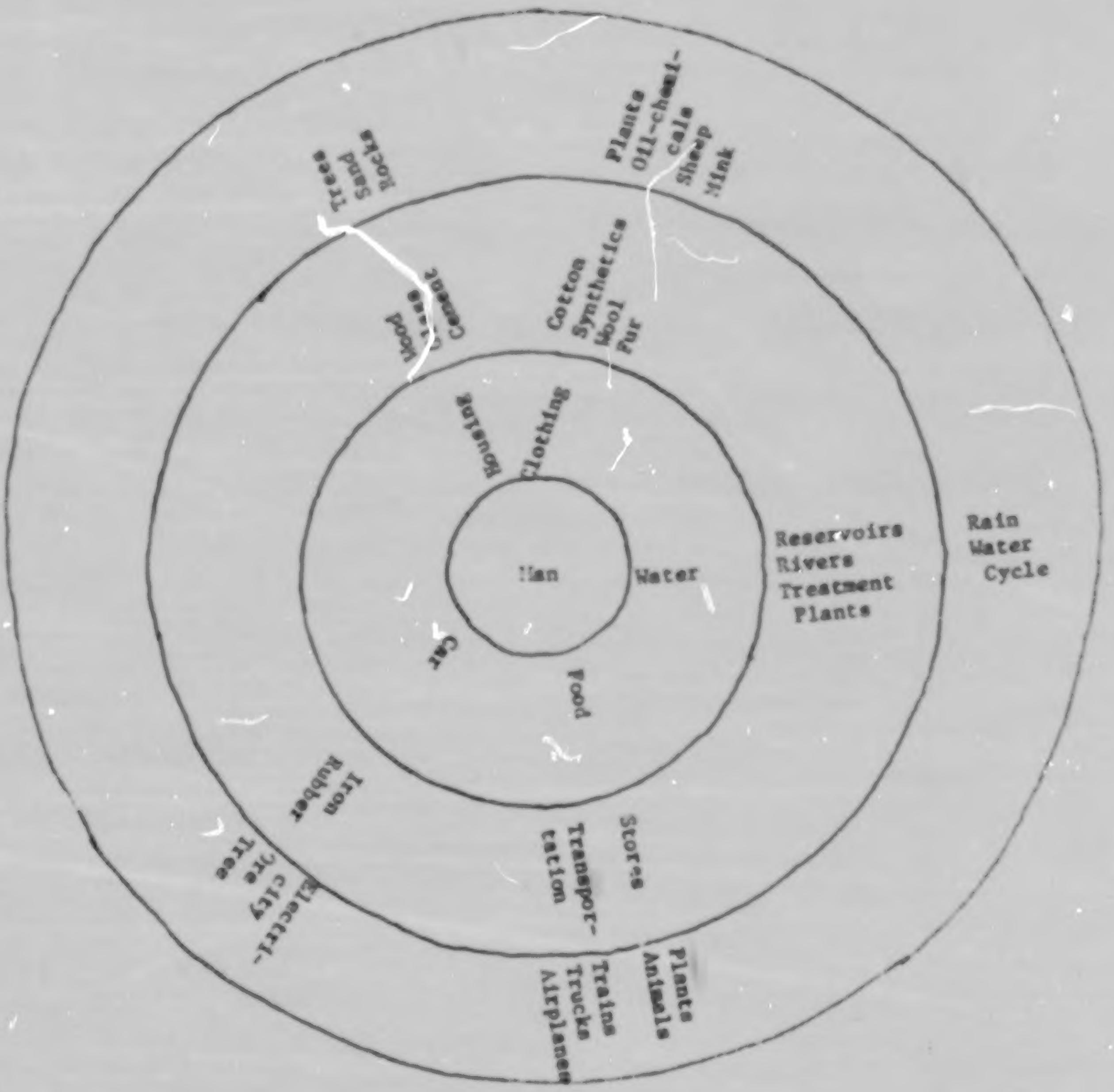
8. Touch-Me-Not Seed: After ripening, when the pod is touched, the pod snaps open throwing the seeds away from the parent plant.

9. White Ash Seed: Seed wing caused the seed to be carried by the wind to new locations.

10. Slippery Elm Seed: The thin membrane surrounding the seed helps the seed float in the wind.

11. Apple: Animals eat the complete apple. Seeds are not digested and grow wherever the animal's waste material is dropped.

MAN AND HIS ENVIRONMENT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Clothing
Water
Food
Car
Wood
Glass
Cement
Cotton
Synthetics
Wool
Fur
Reservoirs
Rivers
Treatment Plants
Stores
Transportation
Iron
Rubber
Trees
Sand
Rocks
Plants
Oil-chemicals
Sheep
Mink
Rain
Water Cycle
Plants
Animals
Trains
Trucks
Airplanes
Electricity
Ore
Tree

Directions for Establishing and Maintaining Plants and Animals in the Classroom

There is no better way to understand life and its many forms than through daily contact. Several suggestions for ways and forms of life you can maintain in the classroom are provided. All the suggestions given contain only simple procedures. None of the suggestions are completely trouble free, but will produce workable results most of the time. Various ones can be assigned as student projects with everyone benefiting from observing changes.

Use the live organisms as teaching tools by having daily or weekly observations and record keeping. Have students do research on various aspects of each organism's influence and relationship. Have the students suggest ways to design experiments to find answers to questions.

Students, not the teacher, should be responsible for caring and maintaining the various organisms. Do not always be cleaning and starting over. Sometimes the unexpected or failure is the best teaching tool. Do not always be telling what is going to happen, it probably will not occur anyway. Students are the best source for things like goldfish and animals that can be collected.

1. Aquaria--Every three or four students can establish a gallon jar aquarium. As this bottle is small, it limits the amount of life that can be maintained. Surface area is the most important factor so don't fill a jar completely to the top. Use goldfish, minnows, or guppies and about one gallon of water for each inch of fish. One fish is enough for an aquarium. Put in a water plant and a snail to start a more nearly balanced aquarium. Be sure not to use chlorinated water without letting it sit for at least a day. Usually some student has an excess of fish to provide for everyone. Have students research proper care of aquariums. It is important that the students get involved and feel ownership if they are to make careful observations. A large classroom aquarium is a nice addition and excellent habitat for comparison, but not a substitute for the individual ones.

2. Terraria--Every three or four students can construct a simple terrarium by getting a large mouth gallon jar, placing it on the side and filling the lower 1/3 with soil. Small plants and soil can be transferred in the winter, and plants or seeds will start to grow when warmed. Add a few insects and slightly moisten before closing the lid. Allow to lay on the side in a warm room. Many changes can be observed over a period of time. Don't throw out plants when they look dead. They often will start growing in a few weeks. This death and new growth is an excellent way to lead into discussions about succession. The wide mouth jars can be obtained from food service centers or the Environmental Education Project.

3. Bottle garden--Each student brings any type of bottle, partially fills it with soil, and plants seeds in it. Moisten to his desire and observe.

4. Algae garden--A collection of algae can be easily started by setting up a gallon bottle for an aquarium (described above), but leave out all but the water plant. Use a bottle of aquarium plant fertilizer (purchased at any pet shop), and fertilize at about three times the recommended rate. Place a light (40 watt flourescent is best) over the garden if possible, and leave it on 24 hours a day. Make sure that the water temperature is not changed more than a few degrees.

5. Micro-organisms--The microscopic organisms never fail to catch a student's eye. Any natural water supply will contain several kinds. To produce a rich culture place dry grass and some soil in a jar partly filled with non-chlorinated water. After 24 hours, you should find many microscopic beasts either on the surface, on the bottom, or on the grass blades. This will be even richer if you can add dry alfalfa and some manure to the culture. Keep the culture and view it over several days. Try cultures using different plant and water types.

6. Mold--Many natural molds can be cultured and observed by leaving various food samples exposed to the air. The samples will need to be kept moist. Bacteria will also be growing on the food and unless large colonies are formed, the bacteria cannot be seen without magnification. Odors from decomposing can be observed. Spore cases or reproductive structures will be observed on the mold. Many colors can be seen. Use a hand lens and observe the mold fibers growing into the food. Some mold groups can be identified observing the spore case shape and patterns and using reference.

7. Peas and Beans--Seeds from either beans or peas can be planted in paper cups with holes in the bottom that will allow excess water to drain. The cup should be filled 3/4 full of soil and the seeds placed about 1/2 inch below the soil surface. During germination the soil should be kept moist, but not flooded. Maintain the plants in sufficient light to prevent them from becoming yellow, thin and tall. Within a few weeks, students will be able to observe the various stages of the plant life cycle. Careful observation every few days of the changes that are occurring will help students grasp the normal growth pattern of plants.

8. Meal worms--Not only can meal worms be used as a food for several reptiles, but can be used for experiments themselves. What temperature do they prefer? Do they prefer light or dark areas? Do they prefer smooth or rough surfaces? Students can design many other interesting experiments.

   Meal worms can be raised in almost any type of container to a depth of several inches with wheat bran or a similar wheat product. This may be mixed with chicken growing mash and hog meal. Place a moistened piece of burlap over the meal and then place another inch of the meal over the burlap. Obtain several meal worms from a pet store or a grain elevator. Cover the container with screen to prevent escape of adults that develop. Add a slice of raw potato weekly. Adults normally develop in early spring and lay eggs from May to late October. Larvae will develop during the winter.

9. Termites and Ants--Termites and Ants are always interesting to watch and relatively easy to maintain. A container can consist of a quart jar placed inside a gallon jar with the space between them. If a thick soil area is available, you will not see the ant trails. The outside should be covered except when viewing. Ants burrow away from light. The soil should be slightly moist and firmly packed in the container. When collecting the ants or termites, gather some of the soil they are in and place it in the container. Weekly feeding of sugar and a few drops of water will be sufficient for termites while ants need some protein like eggwhite. An ant food of one part eggwhite, one part vegetable oil, one part syrup, and two parts water can be made up and stored in the refrigerator. Place a few drops of the mixture in the container weekly.

   Cut open a termite and place its stomach on a microscope slide and view the protozoan inside that digests the wood. The protozoan will remain alive if you place a drop of salt water on the slide.

10. Crickets--Any container will work for culturing crickets. If it is eight or more inches high, no cover will be needed. Place about an inch of moist sand in the bottom of the container. For adults, include a very shallow dish of water. Crickets can live on rolled oats, but a better food is a paste consisting of rolled oats, sugar, skim milk powder, and water. Dry the mixture and cut into about inch squares. Feed one every few days as needed. Any green plant material can also be used as food, but remove it if it molds. A chameleon can be added to the cricket culture and observe the predator-prey relationship.

11. Cockroaches--Cockroaches are excellent for illustrating incomplete metamorphosis, as well as an interesting critter to watch. Almost any container with a screen cover that can be darkened or kept in a dark place will do fine for their home. Place several layers of glass, separated by 1/4 inch in the container. The roaches will live in the layers. Water is best supplied from a bottle inverted in a shallow dish. Place a microscope slide under the edge of the bottle to allow water to enter the dish. Place cotton cotton around in the dish to prevent drowning. Food can be dog biscuits supplemented by potato, apple, and lettuce on a weekly basis. The container will rarely need cleaning. Sawdust can be added to the container if desired.

12. Fruit Flies--Fruit flies can be collected by leaving some overripe fruit, like bananas, in an open jar outside anytime except mid-winter. The flies require a fermenting material, moisture and solid area for an egg laying surface. Many elaborate formulas exist, but a simple and inexpensive media for use in the classroom consists of placing a ripe banana, yeast, paper towel and some water in a jar. Cover the top so air can enter. Add moisture when needed. If you have problems with mold, it is easier to start over than to control the mold. The mold can prove to be interesting to observe.

    The fruit flies can complete a life cycle every seven days, thus are excellent for observing population growth. The eggs are very small and require extreme care if they are to be observed. The larva, pupa, and adult stages are easily viewed and are interesting to view. Males and females can be identified. When raised in a jar in which no food is added, you can observe the effects of a limited food supply, the accumulation of waste, and the growth and decrease of a population within a few weeks.

13. Houseflies--Although most people are familiar with the adult housefly, few people have viewed the complete life cycle. Being larger than the fruit fly, it is easier to observe. It is sometimes harder to maintain in a confined area than the fruit fly. The stages of a housefly vary slightly from those of a fruit fly.

    To establish a housefly culture, start with a one gallon jar, covering the bottom about one inch deep with horse manure or a mixture of rolled oats, bran and alfalfa pellets. Add a pinch of mold inhibitor such as sodium propionate. Place dry powdered milk or granulated sugar in a small jar lid as food and place on the horse manure. Place a small bottle containing water beside the food pan. Fix a wick using cotton or paper towel to draw the water from the bottle. The lid on the gallon jar should have screen or other material that will allow free passage of air. Stock your jar with a few adults and you are in business.

Laboratory colonies are frequently lost because the medium has not been kept moist. Moisture needs for developing flies will vary during the different stages of development, with the larva thriving in a wet to very moist environment and the pupa developing best under drier conditions. The amount of moisture available will affect the rate of development. If the medium is kept wet at the bottom, the larva will utilize the area of optimum moisture and will migrate to the drier portion for pupation.

The sexually mature housefly (10-14 days old) will lay about 120-150 eggs within 4-8 days after copulation, and the larva will hatch in 8-12 hours. The larva will go through three instar stages (24 hours - 24 hours - 3 days) and into the pupa stage for 3 days. Temperature will affect the length of each stage.

14. Gerbils--Gerbils are a relative trouble free mammal to raise in the classroom. The odor that is common with most mammals like rats and mice is almost missing. Any cage with about a cubic foot space will house a pair of gerbils. Gerbils are an arid land animal and can survive on very little water. If you do not wish to use a water bottle, just place an apple or potato in the cage and they will have sufficient water. Food can consist of any grain and leafy green plants. Sometimes it is helpful to add a few drops of vitamins to the food or water supply. The cage will only need infrequent cleanings if you use sawdust in the bottom.

    The gerbils should be provided with something they can hide within, a used towel roll will do fine. The male will help care for the young if left with the female. Often, the young will be scattered throughout the cage when born, don't become concerned.

15. Earthworms--The common earthworm feeds mostly on decaying leaves. The worms may be kept in a box that is around twelve inches deep. Fill the box with a mixture of leaf loam and old leaves. The best samples can usually be found in wooded areas with a good ground cover. Keep the material moist but not wet. No additional food will be needed. When stocking your box, do not add any injured worms. Keep the box at a temperature of about 60°F. and cover with a glass plate. Put no more than 50 worms per cubic foot of soil. Once established, do not disturb for a few weeks other than to check for moisture. In two or three months, examine the soil for changes in texture. Have the worms multiplied or layed eggs? The eggs will be yellow, football shaped, tough skinned, and about 1/8 inch long. Have the worms grown? The earthworm is very important as a decomposer as well as a soil mixer and aerator.

16. Guppies--Guppies are a common tropical fish that gives live birth and are easily maintained in classrooms. The most common problem is being sure the adults are removed from aquarium as soon as the young are born or else the young will be eaten. This can be accomplished by placing the adults in a cage within the aquarium that allows the young to escape. A supply of guppies can usually be obtained from one or more students. Commercial food is available for guppies from local pet dealers.

17. Frogs--Observing frog eggs hatch into tadpoles and then into adult frogs can prove extremely interesting.

Frog eggs can be collected from ponds in the spring or ordered from commercial suppliers such as American Science and Engineering Inc., 20 Overland Street, Boston, Massachusetts, 02215, or Rand-McNally and Co., P.O. Box 7600, Chicago, Illinois, 60680. Within four or five days the eggs will hatch into tadpoles. Most tadpoles will start developing legs within six weeks. Depending on the type of frogs they could be leaving the water within two or three months. Many of the tadpoles will die and be eaten by the others, this is normal. If there is an excessive number of dead ones they should be removed. Do not feed the tadpoles as they will eat the algae, elodea, and duckweed that should be in the container in which they are kept. Use either aged tap water or pond water for rearing the tadpoles and replacing the evaporated water. If water conditions are not near ideal for the tadpoles, they will often not develop all the way into adults.

APPENDIX D

Rivers and Reservoirs

The items in Appendix D are designed for use with the content of Topic III, Rivers and Reservoirs. Suggestions for using each item are included in Topic III. Teachers should feel free to modify activities and materials for best utilization within their classroom.

Rivers of Kansas Map. D-1

Missouri River Watershed. D-2

Raindrop Splash Diagram D-3

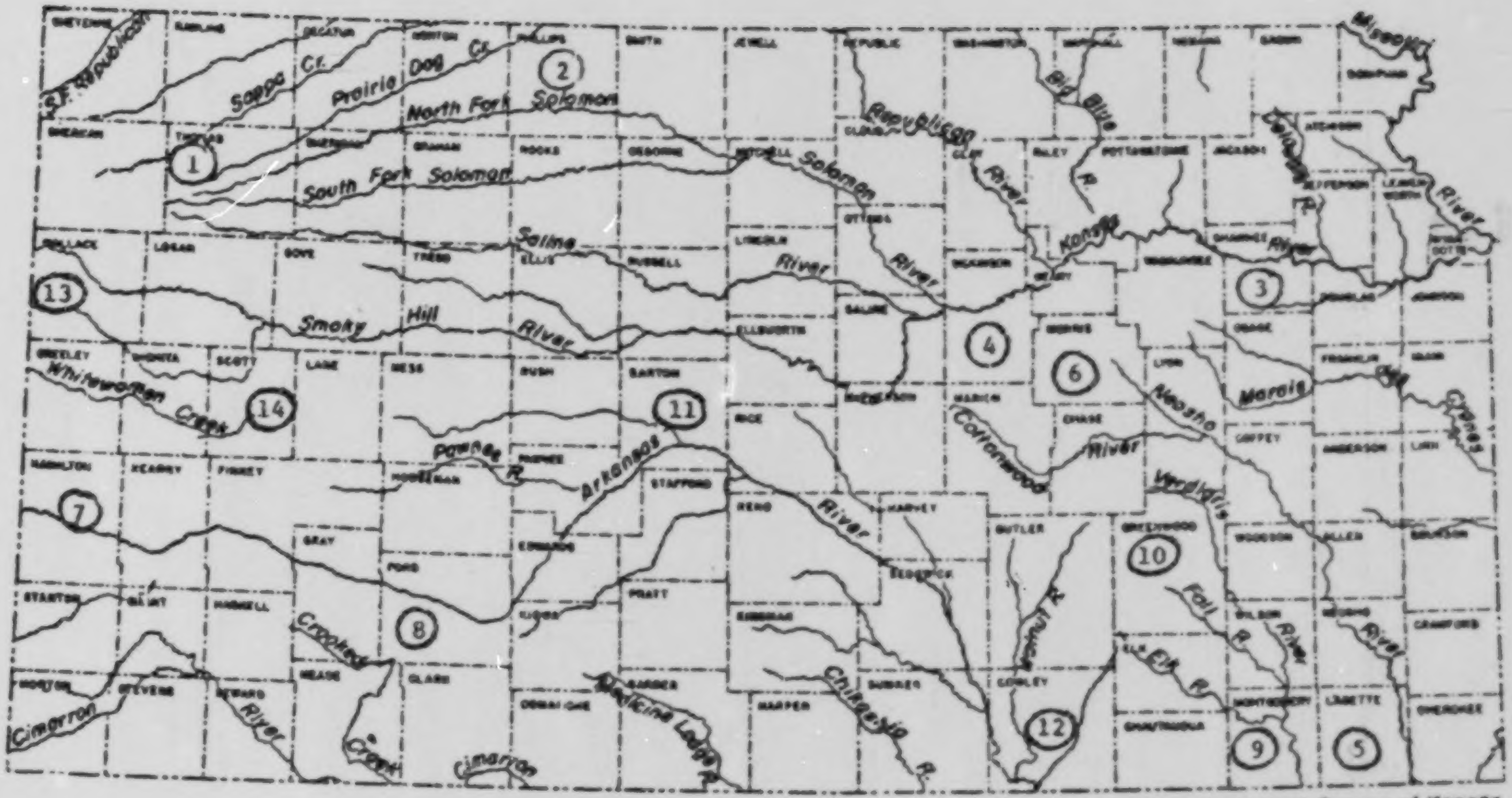
If You Insist on Drowning D-4

Reservoir Navigation Aids and Marker System D-5

Drownings in MRD Reservoirs D-6

APPENDIX D

RIVERS OF KANSAS


S.F. Republican
Sappa Cr.
Prairie Dog Cr.
North Fork Solomon
South Fork Solomon
Solomon
Republican
Big Blue
R.
River
Missouri
River
Delaware R.
Kansas
River
Saline
River
Smoky Hill
River
Whitewoman Creek
Pawnee R.
Arkansas
River
Cottonwood
River
Neosho
Marais
des
Cygnes
Verdigris
Fall R.
Elk R.
River
Walnut R.
Crooked
Creek
Cimarron
River
Cimarron
Medicine Lodge R.
Chikaskia R.
1
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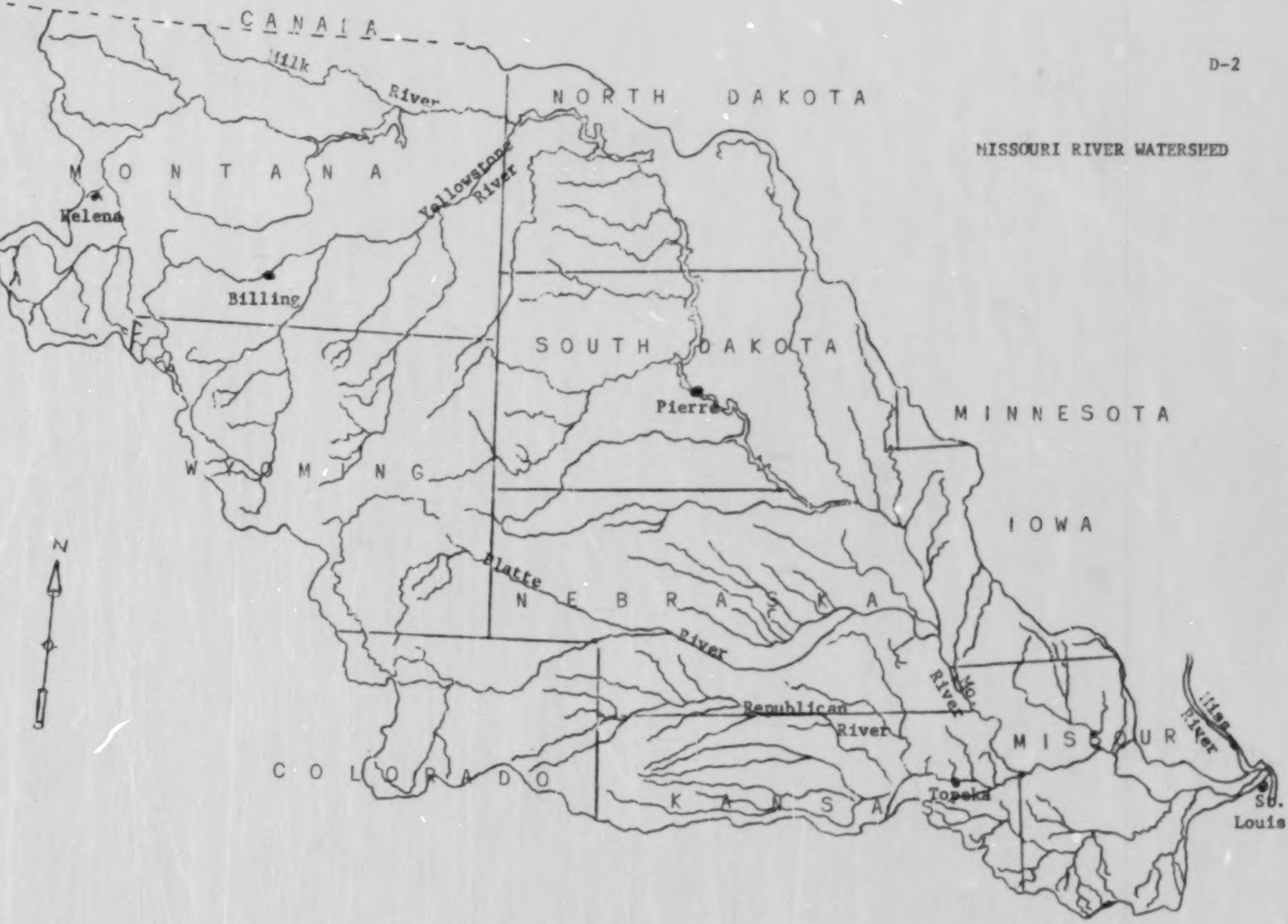
14

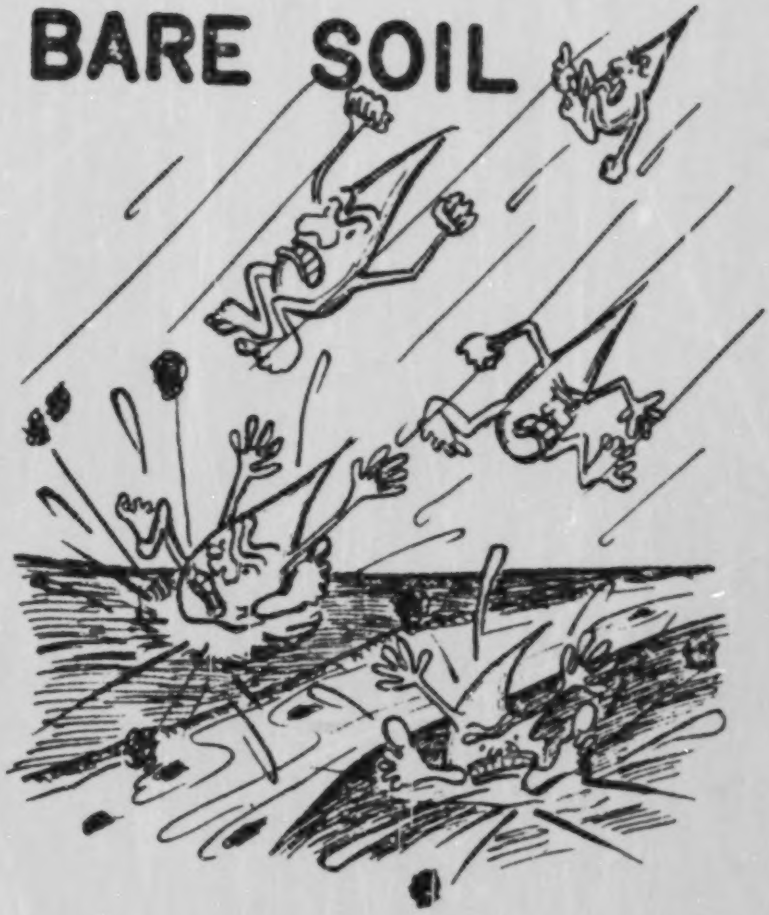
State Geological Survey of Kansas

MISSOURI RIVER WATERSHED


CANADA
Milk River
NORTH DAKOTA
MONTANA
Helena
Yellowstone River
Billing
SOUTH DAKOTA
Pierre
MINNESOTA
WYOMING
IOWA
N
Platte River
NEBRASKA
Republican River
Mo. River
MISSOURI
Miss. River
COLORADO
KANSAS
Topeka
St. Louis

RAINDROP SPLASH

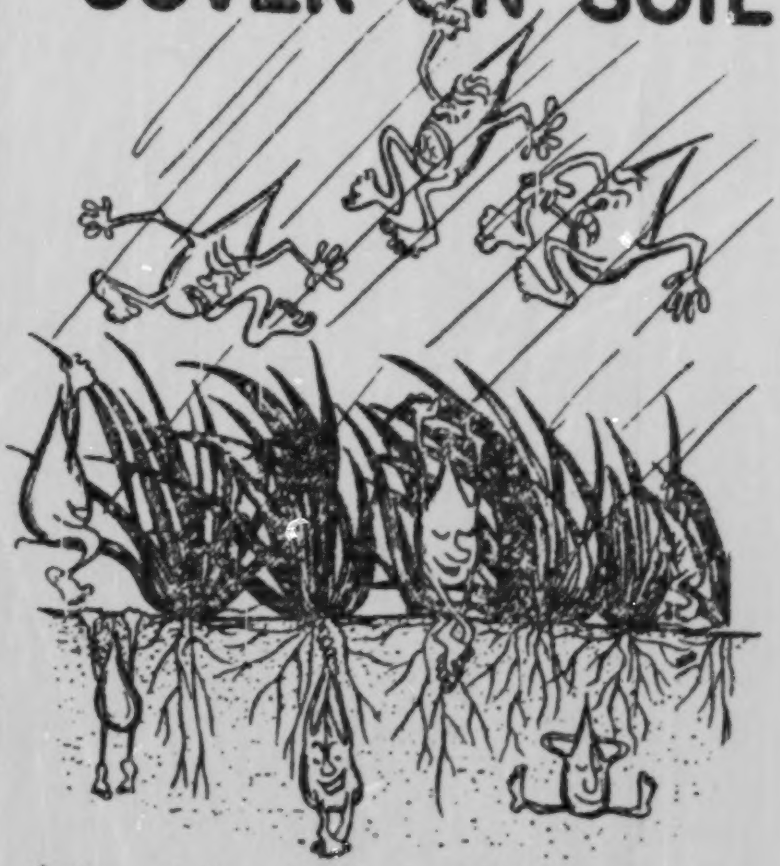
BARE SOIL



High water loss – High soil loss
__LOW__ Production

FROM 4-R-11597, FORT WORTH, TEXAS

COVER ON SOIL



Low water loss – Low soil loss
__HIGH__ Production

SCS-140

APPENDIX E

Archery

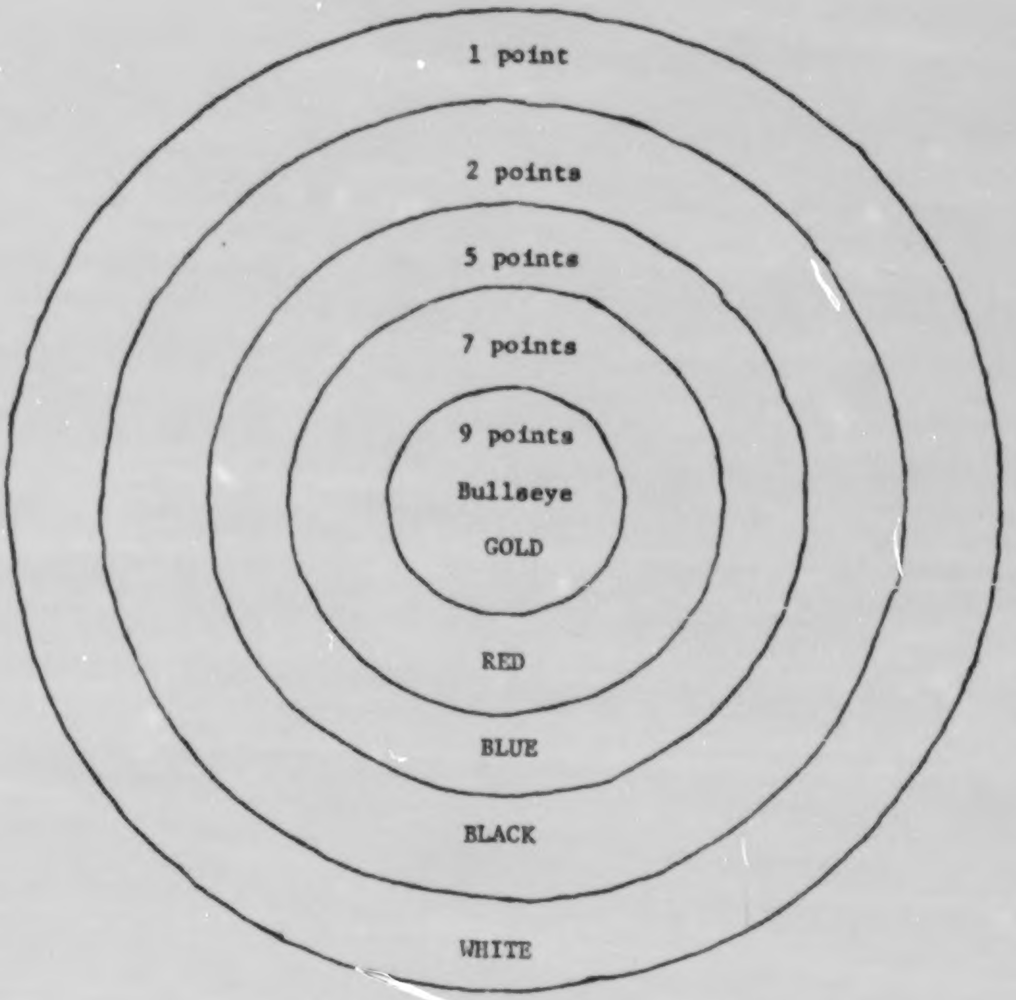
The items in Appendix E are intended for use with Topic IV, Archery. Suggestions for using each item are included in Topic IV. Teachers should feel free to modify activities and materials for best utilization within their classroom.

Archery Target Diagram. E-1

Bow and Arrow Diagram E-2

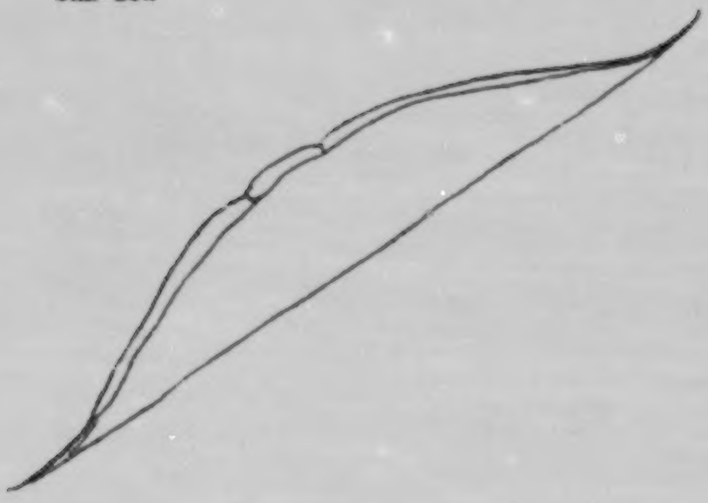
Sample Archery Safety Poster. E-3

ARCHERY TARGET

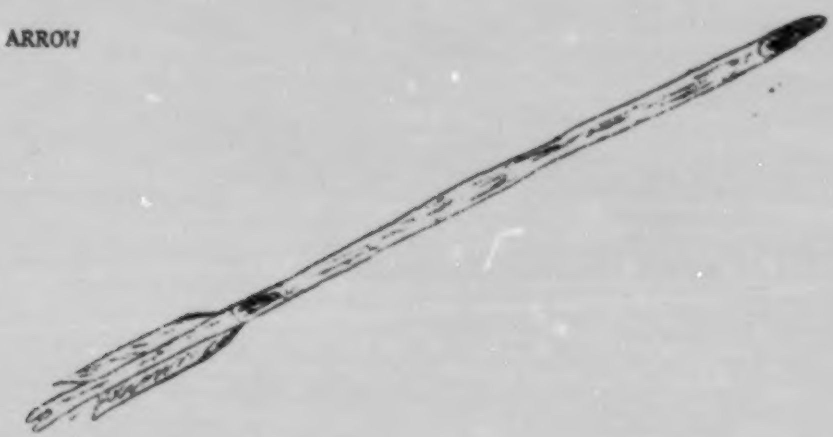

1 point
2 points
5 points
7 points
9 points
Bullseye
GOLD
RED
BLUE
BLACK
WHITE

Bow and Arrow Diagram

THE BOW

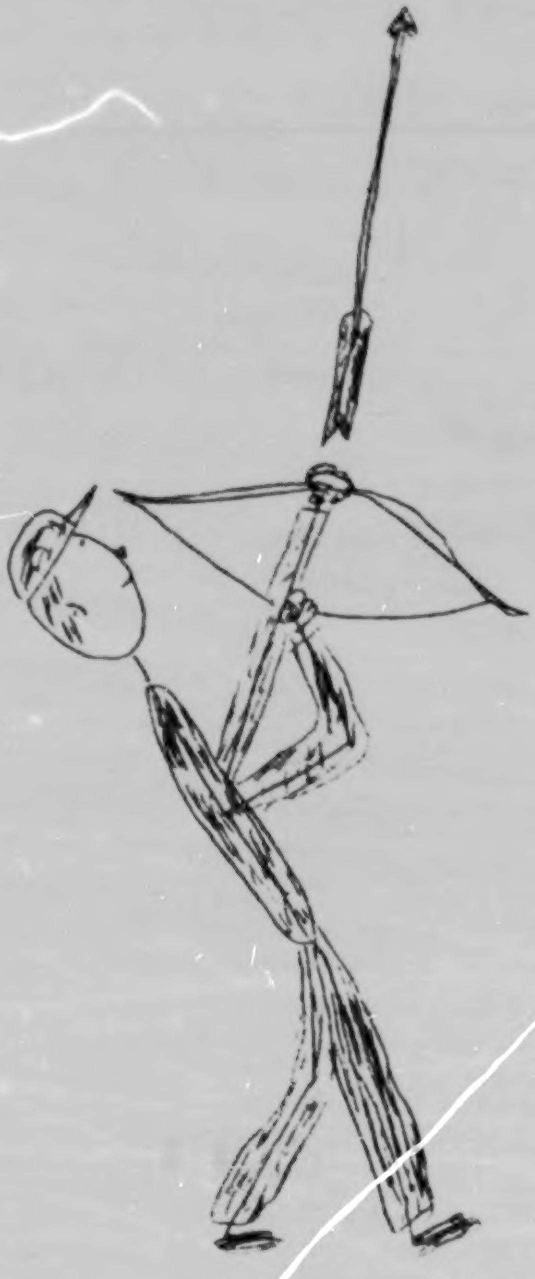


THE ARROW



Sample Archery Safety Poster

Always follow safety rules —



Where it goes nobody knows

This is dangerous.

APPENDIX F

FIELD TRIP PREPARATION AND ACTIVITY

Information in Appendix F pertains to the field trip experience to Lake Perry. Teachers should become familiar with the various activities that will occur during the field trip and complete the necessary administrative and classroom preparations.

Sample Request to Principal for Field Trip F-1
(Forms are available from your building principal)

Sample Letters to the Students Parents (Choose only one) F-2
(Contact your principal to determine which form to use)

Field Trip Schedule and Activities F-4

Student Field Trip Directions F-6

Teacher Field Trip Checklist F-7

Tuffy's Lower Trail F-8

Upper Trail F-9

Hidden Lake Trail F-10

Places of Interest F-11

Sample

THE TOPEKA PUBLIC SCHOOLS
REQUEST TO PRINCIPAL FOR FIELD TRIP
Elementary Schools

F-1

Date Submitted__________

Any classroom teacher who plans to take a group of students on a field trip should discuss the details of the trip with the principal of the school in advance of the date for the trip. In most cases, this planning with the principal should be done two weeks in advance of the trip. This form should be properly completed in duplicate and signed by the teacher and the principal. One copy is filed in the office of the principal and the duplicate is sent to the Office of Instruction to be filed there.

School______________________ Grade_______ Number of Pupils______________

Date of Trip________________ Leave______________ Return________________

Description of Trip: Leadership during the field trip will be provided by the Outdoor Education staff. The trip will include: 1) a study of geology, 2) a study of plant and animal relationships, and 3) an archery experience. The field trip will utilize Calhoun Bluffs and the school site at Perry Reservoir.

Objectives of Trip:

1) To develop in each student an appreciation for the out of doors.
2) To provide each student with first hand geological observations.
3) To provide each student with an opportunity to observe plants and animals within a natural environment.
4) To provide each student with an opportunity to use a bow and arrow.

Means of Transportation: School buses will be provided by the Outdoor Education Program.

Required Cost Per Student______________________________

Teacher's Signature______________________________

- -

I approve the above request and accept responsibilities for the field trip as stated in the guidelines on the reverse side.

Principal's Signature______________________________ Date______________

The Topeka Public and Parochial Schools
Unified School District No. 501
Outdoor-Environmental Education Field Trip

Dear Parent:

Your youngster's class will be taking a field trip to the outdoor education site at Lake Perry on___________________________.

Students will be picked up at school between 8:30 and 8:45 a.m. and returned to the school between 3:30 and 3:45 p.m. They will need to bring a sack lunch and should be dressed for the weather. Their day will go much better if they are overdressed as they can always shed clothing if it gets too warm. We will not be doing any water activities on the lake such as boating, canoeing or swimming, but they should wear old shoes suitable for hiking. If it is a warm day, they could wear tennis shoes as they may get their feet wet catching crawdads in a small stream.

This is an enrichment program that will make some of the things they have been studying in the classroom more meaningful to them. We are simply taking the walls, floor and ceiling off their classroom and for one day they will have a ninety-acre classroom.

The field trip will be under the guidance and supervision of Mrs. George (Barb) Stanley and Mr. C. L. (Tuffy) Kellogg. If you have any questions regarding the program, please feel free to call them at 357-0351.

The Topeka Public and Parochial Schools
Unified School District No. 501
Outdoor-Environmental Education Field Trip

Dear Parent:

Your youngster's class will be taking a field trip to the outdoor education site at Lake Perry on________________________.

Students will be picked up at school between 8:30 and 8:45 a.m. and returned to the school between 3:30 and 3:45 p.m. They will need to bring a sack lunch and should be dressed for the weather. Their day will go much better if they are overdressed as they can always shed clothing if it gets too warm. We will not be doing any water activities on the lake such as boating, canoeing or swimming, but they should wear old shoes suitable for hiking. If it is a warm day, they could wear tennis shoes as they may get their feet wet catching crawdads in a small stream.

This is an enrichment program that will make some of the things they have been studying in the classroom more meaningful to them. We are simply taking the walls, floor and ceiling off their classroom and for one day they will have a ninety-acre classroom.

The field trip will be under the guidance and supervision of Mrs. George (Barb) Stanley and Mr. C. L. (Tuffy) Kellogg. If you have any questions regarding the program, please feel free to call them at 357-0351.

Students will not be permitted to go on the field trip unless this form is returned with the parent's signature.

I give my permission for____________________________to accompany his class on the outdoor education field trip to Lake Perry.

____
Parent's Signature

FIELD TRIP SCHEDULE AND ACTIVITIES

This schedule is for fourth grade students taking the outdoor-environmental education field trip to Lake Perry. This field trip is one of the activities students experience while studying the "Knowing and Using Your Environment" unit.

8:30-8:45 Leave school

Traveling to Perry Reservoir will be by Highway 24. Locations listed on the Places of Interest sheet (see Appendix F-11), will be discussed when they are passed.

9:00-9:15 Calhoun Bluffs

Students will get off the bus at Calhoun Bluffs to gather fossils, which are exposed and are easily obtained.

10:00 Arrive at Lake Perry Site

Upon arrival at the site, students will be assembled in one group for orientation. The location of the restrooms and water will be pointed out. The following guidelines will be made: 1) Do not run; 2) Do not pick up snakes; 3) Pick up every scrap; 4) Keep paper cup for use all day; 5) Leave nature as undisturbed as possible: 6) Listen for and follow instructions quickly; 7) Take care of personal needs during the day; 8) Keep petty complaints to yourself.

During this time too, a moment to enjoy, to feel, to realize, to look, to listen will be provided.

10:15 Students form three groups

The students will then divide into the three groups which were designated by the classroom teacher prior to departure from the school. Two activities will take place before lunch, with a third to take place after lunch. Each group will be with a different group leader for each of the three activities. It should be noted that trails will be developed and modified by the group leaders to best utilize the organisms available and to prevent paths from being developed. The trail directions will be given verbally to the students. Water samples can be collected at either the pond, lake shore, or stream for use in the classroom.

10:15-11:30 Group I--Tuffy's Lower Trail (See Appendix F-8)

One activity will be a trail including lake shore, cove and stream, and meadow areas. Along this trail, examples of plants and animals and their adaptations, variations, and interaction will be observed. The use of all of the senses will be encouraged. A list of possible items for observing has been compiled. (Aids for Group Leaders, Appendix F.) The trail will lead back to the headquarters area where the group will meet a different leader to go on a second trail.

10:15-11:30 Group II--Upper Trail (See Appendix F-9)

The second trail will include an area where succession from pond, to grassland, to woodland can be observed. The majority of this trail will take place in a hilly woodland area. Each student will have a hand lens for use during this session. On this trail the students will observe the stages of succession from a large vantage point, and will more closely compare the resultant variations and adaptations through multi-sensory observations. The tracing of plant and animal life cycles and of food chains will be experienced. This trail also will lead back to the headquarters area.

10:15-11:30 Group III--Archery or Hidden Lake Trail (See Appendix E and F-10)

This group will participate in archery, if weather permits. The emphasis of this activity will be the development of safe practices and of a degree of competency which shall afford enjoyment. If the weather is judged too harsh for this relatively stationary activity to be comfortably enjoyed, the Hidden Lake Trail will be followed. This trail will feature a large pond, where concentrated study of pond life may be experienced.

Most groups enjoy singing during the ride back to Topeka. This can be a very enjoyable experience if they have prepared appropriate songs.

For those groups who collected money for cider slushes, we will stop at Rees Apple Orchard.

Be sure to loosen the caps on the water samples as soon as you arrive back in the classroom, otherwise many of the organisms will die.

Following the field trip, students should be provided with an opportunity to discuss their reactions to the experience, view the micro-organisms in their water samples, and study the data collected.

11:30-12:30 Group I--Upper Trail
Group II--Archery or Hidden Lake Trail
Group III--Tuffy's Lower Trail

12:30-1:00 Eat sack lunch. Water will be provided.

1:00-2:30 Group I--Archery or Hidden Lake Trail
Group II--Tuffy's Lower Trail
Group III--Upper Trail

2:30 Return to school building

STUDENT FIELD TRIP DIRECTIONS

1) Dress according to the weather. Remember it is cooler by the lake and you will be outside all day. Wear long pants because of poison ivy and thorns. Wear old clothes as they might get wet or muddy. Wear old, comfortable shoes as there will be a considerable amount of hiking.

2) Bring a sack lunch with your name on it. Water will be furnished, but you may bring canned pop (no glass bottles).

3) Students are not under any circumstances to catch snakes.

4) All students must listen to the directions given by the leaders and follow the directions closely. Not following directions could cause injury to a student and always will waste valuable time.

5) Disturb the area as little as possible, so other students can enjoy it. Do not break tree limbs, kill animals, destroy plants, or ruin animal tracks.

6) Help keep the site litter free by properly disposing of lunch sacks and other trash.

7) You can bring a camera, but it may get lost. Cameras also prevent complete use of the hands.

8) Collect only three or four fossils at Calhoun Bluffs and make sure they are not left on the bus.

9) Bus rules:
   (a) always remain seated while the bus is moving.
   (b) head and arms are never to be extended out the windows.
   (c) no loud talking or whistling.
   (d) singing is permitted and desired at appropriate times.

10) Make the day happy for others by being a good sport. Don't complain.

11) Have FUN! The field trip is to be a fun day and you will also learn a lot.

TEACHER FIELD TRIP CHECK LIST

1) Make sure the scheduled date for the field trip does not conflict with other school activities.

2) Complete the Request For Field Trip form and submit it to your principal.

3) Prepare and send home parent permission forms. Use the form designated by your principal.

4) Do appropriate pre-trip teaching.

5) Invite the principal, parents and others interested to go on the field trip.

6) Review the student directions with the class.

7) Have the students divided into three groups.

8) Use masking tape to make name tags.

9) Have the students go to the bathroom before boarding the bus. (There is an outdoor toilet at the site.)

10) If you wish to collect water samples or materials for a terrarium, take proper containers.

11) Take a camera if you wish.

12) Each student will be responsible for his own lunch. Do not place them all in one box.

13) The first class will load on the bus near 8:45 a.m. Students will be returned just before the end of the school day.

14) Assign each student a "buddy" within his or her group.

15) Be ready to assist at the site if requested.

TUFFY'S LOWER TRAIL

Lake Shore and Cove - Stream - Meadow

1. Stress that we are going to go exploring and blaze some new trails.

2. Count students, get everyone a buddy and let them know that we will do everything as a group. Can and should explore on their own, but not to stray too far. Whistle means they are to return to group.

3. Look for signs of animal life, beavers, deer, rabbits, opposum, raccoon, mice, birds and frogs.

4. Turn them lose in meadow and tell them we will meet in cove of trees. If it is the first group, they may want to run. This is a good area!

5. Discuss differences in the meadow area, headquarter area, lakeshore and creek.

6. Examine blade of brome grass and look for M's. Run fingers both ways on blade of grass. Try to whistle with blade of grass placed between thumbs.

7. In the cove area there are many trees chewed by beaver. Count the tree rings to determine the tree's age.

8. Look for lichens, fungus, and moss on trees.

9. Observe dead trees in cove. Why are these dead? What are the needs of green plants? Good place to talk about producers, consumers, and interdependence.

10. In the creek area during late spring and most of fall, one can find crayfish and other living animals in water.

11. Lower meadow - has a variety of grasses, mostly blue and brome. In one area there is an abundance of milkweed. Look for butterflies, other insects, and mice runs.

12. Kids will love to walk the lakeshore and find all kinds of odd-shaped pieces of wood, bark, bottles, fish bobbers, etc. Good place to look for frogs and tracks of raccoons, etc. Late fall can attempt to sneak up on ducks that are usually in weeds along shoreline. See if they can tell where creek channel is or was before lake was built.

13. Upper creek bed and banks can be used to talk about erosion, weathering of rocks, glacier, top soil, moss and algae.

14. Good example of decayed logs, square plants (carpenter's square), barb wire in tree, hollow sycamore, log for bridge, moss, fungus, dead trees used by Woody Woodpecker for food and homes.

15. Farmyard area - old outhouse. Can use wild onions to check senses - sight, feeling, smell, taste. Use cottonwood tree in fall to listen to leaves.

16. Variety of trees and plants, fruit, asparagus, flowers, etc., in yard area.

17. Many possibilities to work in adaptation - frogs, fish, ducks, woodpeckers, willows, etc.

UPPER TRAIL

Immediately south of headquarters area is an excellent area for observing and studying grassland to woodland succession.

In this area opportunity is given to explore, to use all senses, and to experiment with hand lens. Guidance as to what should be tasted (buckbrush, sumac seeds); touched (walnut bark, hickory bark, soil); smelled (soil, weeds, et al); listened for (birds, insects, wind); seen (lichen, animals in the soil, nests, et al); is offered. A quadrant study usually takes place here.

Opportunity to locate and blaze a trail southwest from the base camp to a large cottonwood tree is given. Under the cottonwood is a dried up pond where sandstone can be found. Insect galls are usually prevalent in this area. Aesthetics of dancing cottonwood leaves are enjoyed here.

On to an old pond where limited pond life can be observed - cattails, muddy water, frogs - a good opportunity to observe pond changes. Results of erosion are experienced in the approach to this area. Usually food chains can easily be traced here.

A walk through a relatively new woodland area leads into a climax forest. Comparison of the two is easily done. Stop here to listen, look, feel, enjoy. Participate in another quadrant study. Compare the findings here with those of the grassland. Climb the hill at individual pace, with instructions to find on the way up moss, fungus, or mold, decomposed wood, signs of animals, lichen, three different oak leaves. Wait at top to discuss observations. Rest, look and listen. Observe Slough Creek valley. Determine how and why it may have been used. The wagon trail leads the group back to the headquarters area. Take the wagon trail back to the headquarters area. Determine how and why it may have been used.

The study of this trail will take about an hour and one-half.

HIDDEN LAKE TRAIL

Leave camp headquarters and follow the road north to Barb's bridge. Remind students to leave rocks on the road and not to throw them.

There are usually good examples of poison ivy along the ditch by the road.

Virginia creeper is plentiful in the area and has wound its way to top of the big oaks.

Barb's bridge - kids will want to walk under it. Good place to look for tracks, algae in small pools. Generally small fish and crawfish in pools.

Move quietly. Go up stream about 50 feet and there are generally carp, blue gill, sun fish and minnows in pool.

Old hand pump is interesting. Water not fit for use at this time. May have to prime the pump but it does work. Many snakes in and around the well in fall - late fall and spring especially.

Up the little stream about 50 yards can be found many good examples of large rocks that have been and are being eroded by water. These rocks are real interesting to students as water has worn holes and valleys in some pretty good sized rocks.

To the right of the stream as you go west can be found a good example of very poor productive soil. Very little grass - mostly post oak or scrub oak - are found growing in this kind of soil. Good signs of erosion.

The meadow to the left of creek is heavy with vegetation and has many good signs of animals and birds.

This area is one kids can venture out a little further. The leaders instructions are for students to go to the fence and no further. You can generally keep an eye on everyone if you walk the hillside.

Continue northwest to Hidden Lake. This lake is an area where students will love to explore the shoreline for algae, moss, cattails, frogs, and fish. Good place for kids to use their imagination about possible development of area.

Return trip can be a directional hunt for students. Tell them camp is a southeasterly direction. Return to camp taking meadow and follow along base of hill.

If you have time and a rugged group, you can take trail up and over hill. This trail will be challenging to most, but they will love it. This route has great places to sit down and cry as Miss Barb does. You may wish to sit down and rest and talk about what they would do if they were really lost. Review directions and value of compass, maps, etc.

Return to base camp. The trail should take about an hour and one-half.

PLACES OF INTEREST

Kansas River--also called the Kaw River--last major flood, 1951--reservoirs up river were build primarily to prevent flooding. Nine feet of the north end of the bridge was under water. Almost everything was under water except the cloverleaf at the junction of Highways 24 and 75.

Calhoun Bluff--What is a bluff?--Why called Calhoun Bluff?--Used to be in Calhoun County. Students will collect fossils and study rock formations.

Farm Crops--Wheat, corn, milo, alfalfa, soybeans--What crop do you think we will see the most of?

Old Highway 24--Sometimes we take old Highway 24 to new Highway 24 and show contrast of what used to be a modern highway.

Thompsonville--Short history of Thompsonville and Mormons--stop at old church located in Thompsonville.

River Flood Plain--A flood plain is the flat area next to the river banks which is flooded during heavy rains. Is the river always in the center of the flood plain? How was the flood plain formed? Does the flood plain make good farm land? Does the river change its location?

Delaware Ceremonial Hill--discuss important place the turtle held in Delaware religion.

Slough Creek Area--point out road to where sixth graders go when they go to Perry on their field trip.

Point out Lakeside Village Development--they are solving problems with water and waste disposal.

Have students look for these things to discuss in classroom later:

1) Types of roads.
2) Signs of communications--billboards, highway signs, telephone lines, telegraph lines, radio station, mail boxes--endless list.
3) Ways of travel--car, truck, tractor, plane, railroad, boat, school bus, walking, monorail.
4) Signs of transportation--paved roads, gravel roads, dirt roads, railroad tracks, marina, bridges (big and small), plank.
5) Crops--corn, milo, wheat, alfalfa, pasture.
6) Kinds of birds--meadowlarks, doves, blackbirds, sparrows, swallows, crows, ducks, hawks.
7) Signs of erosion along highway and roads.
8) Signs of pollution along highway and roads.
9) Signs of economic changes brought about because of Perry--boat shop, service station, bait shops, eating places, new housing development.

APPENDIX G

HISTORY

The following are short historical notes of interest relating to the various areas the students will be seeing during the field trip experience. They can be used in group discussion or for individual student research.

Social History of Calhoun Bluffs and Kansas River Valley G-1

Geological History of the Calhoun Bluffs Area G-4

Geological History of the Kansas River Valley G-7

History of the Perry Reservoir Site Area G-8

SOCIAL HISTORY OF CALHOUN BLUFFS AND KANSAS RIVER VALLEY

The social history of this area began with its first people--the Indians. It is probable that Indians ranged this part of Kansas since the retreat of the ice age. Before the human element came, the land was occupied by giant buffalo, horses, camel, mastodon, and mammoth. Coal producing giant tree fern swamps and flowering plants were present earlier in its history. Man is the newcomer.

The name of these bluffs, the Calhoun Bluffs, comes from the fact that they were in Calhoun County, Kansas which was later changed to Jackson County. Calhoun County was named in honor of John C. Calhoun. Politicians in early day Kansas, fighting for Topeka to be the county seat as opposed to Tecumseh and other hopefuls, changed the northern boundary of Shawnee County from the Kansas River north to include North Topeka and land for several miles north, so that Topeka would be more centrally located. This was done in October of 1857. This move made the Calhoun Bluffs (which retained their name after Calhoun County was changed to Jackson County) a part of Shawnee County.

Most of the Indians we now think of as living in this area of Kansas were really Eastern tribes which had been displaced and moved further westward by the advance of "civilization". We did, however, have earlier Indians living and hunting and doing some "farming" along the Kansas River Valley, we call them Kansa.

Many of our names are of Indian origin. Kaw River is after the Kaw tribe. Kansas itself means "Land of the South Wind" and comes from the tribal name, Kansa. Topeka is a place meaning "A good place to dig potatoes" or "Wild potatoes." But the North American Indian did not mean potatoes like we know them. They meant by "potatoes" any one of a number of edible roots and the river valley around Topeka was a prime source of them.

Even before settlers actually came to Kansas the area near Topeka was important as a crossroads to the West. One of the feeder trails to the Oregon Trail crossed the Kansas River at Topeka. The California Road followed the highland bluffs that you can see south of the river from Lawrence to Topeka, near the present winding curves of highway 40.

In 1842, Louis Pappan built a ferry across the Kansas River at Topeka. Louis and his wife, Julie, a Kaw Indian, were grandparents of Charles Curtis, later a United States Vice-President. The Pappans and a brother were probably the first white settlers at Topeka. In 1857 a bridge was built although in July of the following year floods tore away the bridge and the ferry business resumed.

In 1865 a pontoon bridge was built and was used until an iron toll bridge took its place. The iron bridge was replaced 20 years later by the Melan bridge which collapsed in 1955. On December 5, 1854 some men organized the Topeka Association and laid out streets and lots. In five years the population grew to 700.

In 1827 Daniel Morgan Boone, son or grandson (information varies) of Daniel Boone was sent, by the United States Government, to teach the Indians, (now forced to a sedentary life), how to farm. They settled on Mission Creek (named for the Kaw Indian mission established there) which had been previously named American Chief Creek. This place was two miles South of the Kansas River. (Some sources say the site was in Jefferson County. It is difficult to decide which source is correct. At any rate, the location was near Topeka.)

Soldier Creek which empties into the Kansas at Topeka got its name because it was a favorite camping ground for soldiers going from Leavenworth to Fort Riley. Tecumseh was the first county seat. It began as a settlement in 1852 and in 1855 became county seat. It was selected as the most beautiful site on the river by the Shunganunga Creek and Kansas River. It almost became the Territorial Capital of Kansas. But Lecompton was the successful rival. The county seat was moved to Topeka in 1859. Rochester began in 1854 on the banks of Soldier Creek. It was first named Delaware City, then the name was changed to Whitfield City, Kanpolis, and then to Rochester. Indianola was a small community at the crossing of Soldier Creek and the military road from Fort Leavenworth to Fort Riley.

The Delaware River which is dammed to produce Perry Reservoir was first named Grasshopper Creek. The name was changed after the plague of grasshoppers in the 1880's. The banks of the river and streams are covered with woods such as Oak, Hickory, Ash, Walnut, Hackberry, Elm, Maple, and Cottonwood. Orchards of apples, peach, plums, and pears were begun with the early settlers. Rees' Orchard remains prominent to this day.

The limestone of the Topeka Limestone formation has been well used as building stone, and many of the older houses are of this durable material; the joints being of mortar also locally made.

Early industry and agricultural ventures in Shawnee County and the Kaw River Valley were quite varied. At one time around 1879-1880, 90 per cent of the apple seedlings grown in the United States and Canada were grown at Topeka in the Kaw Valley. These were grown for many famous nurseries of the time; the still well-known Stark Nurseries of Missouri were supplied by Taylor of Topeka. Skinner also began in the nursery business at this time, and still uses the Kansas River Valley for growing fruit trees and seedlings.

Several factors lead to the decline of the venture. The depression of 1930 finally ended it and probably the most important factor keeping the industry from rebuilding was the changing tastes of the youth from fruits and fruit juices to candy bars as a treat, snack, or dessert.

Also of aid to the nation's sweet tooth was Topeka's sugar industry. Sorghum molasses had been the sweetner of pioneer times. With more refined living accommodations came a desire for a more refined sweetner--sugar. Sugar was quite expensive and so the government offered a bounty for Kansas grown cane and processed sugar. Farmers of the area were persuaded to grow a hundred acres or more of sugar cane. This cane was grown around Topeka on both sides of the river in the Kaw Valley in the late 1880's. A huge processing plant was established and used for a couple of years, finally burning down. The beginning of the panic of 1893 completely closed the operation. Equipment was sold and used for other enterprises for many years. Part of it was the old starch factory.

There were three cigar factories in Topeka around 1880-90 but mechanization finally overcame this commodity, which was hand produced.

Ice was also an important commodity in the 1880's. The Crystal Ice Company, operated by the Skinner Brothers, cut ice in the very cold year of 1884-85 from the Kansas River, stored it in the new ice house and cleared $8,000 the following summer.

SUMMARY

The land where we live and over which we travel in going to the Perry Dam and Reservoir is as old as the universe, but the surface characteristics were produced by forces of deposition by glaciers and wind and water and subsequent erosion and redeposition during the past 1,000,000 years. The mineral resources, our fertile top soil, our water supply and the rugged beauty of the land are our heritages from the past. Man in using his inheritance has hunted the prairie and woodland animals; farmed the fertile valleys and gathered its bounty; he has more recently built cities and factories, mined the fossil fuels, used and reused the water. Some say man has destroyed his heritage. As you examine these bluffs and gaze over the adjoining Kansas River Valley, what do you think?

GEOLOGICAL HISTORY OF THE CALHOUN BLUFFS AREA

A description of the area which includes the Calhoun Bluffs and the Kansas River Valley near Topeka should begin with the present day surface that is easily seen to the north of the river and in a few instances a little south of the river. As you go to Perry Dam and Reservoir from Topeka, you pass through some of the most distinctive land and countryside of any in Kansas. "Civilized" human occupation of this land may perhaps go back only 120 years; but the history of this land began long before this.

This land is, of course, as old as the universe in one way of looking at it. But in the form that you now observe it, in the form of these rocks, rolling uplands, and stream-eroded valleys, its history is one of 235 million years ago.

About this time (235 million years ago) is when these rocks were being deposited under a great inland ocean. These depositional buildups continued to occur for about 25 million years, giving us layers of limestone, shale, and sandstone. The rock strata deposited from 210 million years ago until the past 1,000,000 years have been eroded away in this part (Eastern one-fifth) of Kansas leaving exposed as rock outcrops, rocks of the Pennsylvanian period.

During the Pennsylvanian, 210-235 million years ago, Topeka was covered with water. During these 25 million years (remember - the United States was formed about two hundred years ago) the water slowly changed back and forth between fresh water and deeper salt water as the ocean advanced and retreated across Kansas. This slow changing from salt to fresh to salt water gives Calhoun Bluffs its layers of shale, then limestone, then shale with a couple layers of sandstone.

Starting with the oldest layers of rock (those at the bottom) and working up, we will now explain what each layer looks like, what made it, and what fossils are found in it.

The lowest and oldest member of the rocks exposed at Calhoun Bluffs is the Calhoun Shale. It was given its name because a very good example is found at Calhoun Bluffs. It is the most complicated member in the bluffs, since it has some coal and sandstone sandwiched in the gray shale layers. It also has some deposits of limestone in channels formed by cracks in the shale which were filled in when the ocean covered it in later times. This layer was formed under a shallow fresh water lake that had rivers carrying sand into this area. It has many fossils, but they are mostly Pelecypods.

The sea now invaded Kansas, and the Hartford Limestone was formed. It is a white limestone that weathers brownish, and contains Fusulinids, algae fossils, chambered sponge, (found only in this layer) and almost every other kind of fossil found at Calhoun Bluffs.

The sea now retreated, and Iowa-Point Shale was formed under fresh water. This is a yellowish to bluish-gray shale that has some mica, sandstone, limestone, and coal in it. It contains Crinoids, Bryozoans, and Brachiopods.

The sea invaded for a long time in making the next member at Calhoun Bluffs. The Curzon Limestone is the biggest limestone layer visible in the road cut. It has two to four beds (each bed is slightly different) of bluish-gray to brown, hard limestone. Fusulinids are found in the lower beds with Brachiopods and Bryozoans in the middle, and Osagia Algae common in the top beds. Crinoids, Echinoid spines, Pelecypods and Gastropods are found in all beds. How thick is this limestone?

After the sea finally retreated, and fresh water returned, the Jones Point Shale was laid down. A few fossils are found in this layer, but the most interesting thing to look for are its limestone nodules. These are little hunks of limestone which, when broken, show small crystals of calcite. This layer is about five feet thick in the Calhoun Bluffs cut.

Sheldon Limestone was now formed below the sea. It is a light gray to white limestone that is fine grained and weathers yellowish to gray. Its shape is smooth and rounded, which is not like the sharp angles of the Curzon Limestone. This bed contains fossil algae, Crinoids, Bryzoans, Brachiopods, and Gastropods, with a few Fusulinids.

Once again, the ocean retreated, and this time the Turner Creek Shale was formed. This layer contains some claystone, silt stone, and limestone beds in it, as well as the shale from which it gets its name. It has Crinoid, Pelecypod, Brachiopod, and Ostracode fossils.

The next layer is a thin layer of DuBois Limestone, which is a dark blue to green stone when fresh, but it also weathers to a brown color. This layer contains about every type of fossil found at Calhoun Bluffs.

The highest rock layer in this area is the Holt Shale layer. It is a bluish-gray to black shale deposited under shallow, fresh water. It contains fossilized Brachiopods, Bryozoans, and Pelecypods. This layer is about 210 million years old.

The topsoil of north eastern Kansas was brought here during the Pleistocene Period (the last million years) by glaciers from the north which twice invaded Kansas. The first glacier to cover any part of Kansas was the Nebraskan, which covered only a few extreme north eastern counties. The second, the Kansas glacier, covered more territory, extending as far south as the northern parts of Shawnee, Douglas and Johnson Counties and as far west as Marshall and Pottawatomie County. Altogether it touched or covered thirteen counties of north eastern Kansas.

This glacier brought with it our valuable topsoil, deposited as the glacier melted and dropped its load of rocks and soil and retreated northward. The deposited material was left as it fell with large rocks right alongside small pebbles. It is called unconsolidated Kansas till. In this till are found rock sizes from boulders to clay, sand, pebbles and gravel. Red quartzite boulders are a prominent feature of the landscape and these are easily recognized.

This glacial till, since the retreat of the last glacier some ten or eleven thousand years ago has been weathered and eroded, giving the softly rounded undulating surface of the uplands and broad river valleys such as the Kansas River Valley upon which Topeka is situated. In the Calhoun Bluff area this topsoil is about three and one-half feet thick.

The area to the north of the Kansas River is excellent for collecting rock specimens of exotic types including gemstones of interest to the "rock hound" as well as specimens for the amateur geologists. Some of the more interesting types are: Lake Superior agate, jaspers, brain agate, smoky quartz, rose quartz and banded chert. Granites, geodes, iron ores, native copper, quartzite, boulder clays and other types may also be found. The origin of these materials is from Iowa and farther north, where the debris was scraped from their place of origin and transported in the glaciers to this area and deposited.

The sands and gravels from the Kansas till that have been eroded from the surface and deposited in river valleys in sorted layers are of economic importance. We have several sand companies on the Kansas River at Topeka. The clay of the glacier deposits north of Topeka are also of economic value in the ceramics industry. The very fertile soil of the Kansas River Valley is due in great part to the deposits first brought here by the glaciers and transported then by rivers and streams to the Kaw Valley.

The contours of the land where we live and the surface itself is due to the action of the past million years, glaciation, deposition, then erosion, weathering and redeposition.

GEOLOGICAL HISTORY OF THE KANSAS RIVER VALLEY

To the south of the road cut through Calhoun Bluffs, you see the broad Kansas River Valley. The soil deposited here is the top soil from the drainage area washed down from prairies and plains over the past ten or eleven thousand years.

Soil produced under prairie grasses is the most fertile naturally occurring soil in the world. The reason for this is a combination of factors. First, the temperature is such that chemical processes of breaking down rock happens at a moderate rate, not as fast as it does in tropical regions, or as slowly as in arctic regions. Second, the rainfall is not great enough to leach the soil of its valuable minerals as happens in humid tropical areas. Third, the rain fall is great enough to prevent deserts and to grow a good cover of fibrous rooted grasses whose parts decay, adding rich humus to the weathered rock to form soil and whose roots bind the soil in place and prevent removal by wind or rain. Thus the soil is rich in humus and minerals and it is this soil which is thick upon the Kansas River bottoms, making this area which you can see from the Bluffs some of the most important and valuable land in the world.

The Kansas River erosion cuts mainly to the south side of its banks which makes the streams to the south become steeper (stronger gradients) and thus they have more erosional power and produce the rugged blufts to the south of the river. You can see and drive through these bluffs by taking the "River Road" from Topeka to Lecompton. (Go out Fourth Street East from Topeka through Tecumseh and East.) North of the river, the hills are more rounded with gently sloping valleys.

The Kansas Valley existed before the Kansas Glacier and was perhaps 15 or more feet above the present elevation. During the period of glaciation the Kansas River Valley was cut wider and deeper. The upland were stripped of some bed rock; covered with glacial drift in depth of a few inches to 40 feet. The uplands and the Kansas River Valley were filled by glacial deposit. The most persistent deposits of glacial till are on the crests of the hills north of the river.

HISTORY OF THE PERRY RESERVOIR SITE AREA

6000 BC Prehistoric people lived in the area. This has been determined through the discovery of projectile points in the area.

1st C. AD Mid and late Woodlands peoples lived in circular and oval houses of light pole construction covered with thatch and clay. These were hunting and farming peoples who were either recipients or inventors of the bow and arrow. Cottonwood canoes from logs 15 to 25 feet long and 3 to 4 feet in diameter were used on the rivers.

1803 The area had been claimed by the French as a result of their explorations. It was purchased by the United States Government, during President Thomas Jefferson's administration, as part of the Louisiana Purchase, for less than 4 cents an acre. The entire area was considered worthless and was left to the Kansa Indians.

1819 An exploring expedition, under the direction of Major Long, found the area to be 18 per cent bottom land; 82 per cent uplands; 10 per cent forest; 90 per cent prairie. The first white man in the area was Professor Say of this expedition.

Shortly after this, freighting on the Santa Fe trail was carried on from the mouth of the Kansas River to Santa Fe by "bullshackers."

1825 Delaware Indians, moved by the United States Government from the East, settled in the area.

Treaty between the Kaw and the U.S. Signers were General Clarke and 12 chiefs, including White Plume, who was later to be great, great grandfather of Senator and Vice-President Charles Curtis. At the time of the treaty, the Kaw were a "miserable people living in dirt houses, seldom clothed except by buffalo skins or sometimes a blanket. They were accustomed to living by the chase. Game was scarce, many died of starvation; they had to go 200 miles to get buffalo. If there were not enough horses, women walked and carried the children and the meat. They were ignorant, but teachable," observed Thomas Johnson, a missionary to the Shawnee. According to the treaty, the U.S. was to furnish farming aid, livestock, and equipment. Major Daniel Morgan Boone, son of the frontiersman, was appointed "Farmer of the Kansa Indians." A colony and an Indian agency were set up at Williamstown on the Kaw River. Keel boats brought supplies up the river. Many white hunters and traders came into the area and a few settled and married among the Kaw.

1828 The first white child, son of Major and Mrs. Boone, was born in Kansas.

1829 Treaty with the Delaware Indians by which the U.S. granted to the Delaware all land north of the Kansas River, east of the Missouri River, and west to the land of the Kansa.

1832 The main village of the Kansa was moved to the main reserve in Shawnee County.

1835 Boone opened 300 acres at the new village. He left the agency and returned to Missouri. This was the end of the Williamstown settlement.

1835	John Dunbar, a Presbyterian missionary, visited the Delaware and found Methodist and Baptist missionaries at work. The country was good and many of the Indians had log houses and corn fields. It seemed that many had given up the chase for the white man's ways of living. Whiskey was the deadliest enemy of Indian improvement. The nation numbered about 1000.
1842	The death of Reverend William Johnson, who had had great influence with the Kaw, caused the Kaw to drift from their promises to him to work their farms and to put their children in school.
1843	The Delaware sold thirty-six eastern sections of land to the Wyandotte Indians.
1844	Flood of the Delaware River.
1851	Mormons from Jackson City, Missouri, enroute to Salt Lake, stopped at Thompsonville. They remained two years and then had to leave because the land on which they settled was Indian land.
1854	Government treaty with the Delaware Indians, by which the Delaware ceded their surplus lands to the U.S., retaining a strip ten miles wide, north to south, along the north bank of the Kaw River. The north boundary of the diminished reserve was a little south of the north line of Township 10, the western boundary was a little more than one mile west of the line between Ranges 17 and 18. (U.S.D. 501 tract is the NE one-fourth of Section 21, Township 10 South, Range 17.) They received in exchange a trust fund resulting from the sale of lands by the government to settlers. As a result of civilization John Ingalls wrote, "About 950 Delaware are living in rude huts and live a life of indolent degradation. The government gives them each $100 per year - enough to keep them drunk all the time. They dress in many colors and ride small ponies highly valued for their good disposition and great endurance."
May 30, 1854	Kansas-Nebraska Act, by which Kansas was admitted to the U.S. as a territory. A rush of settlement began with the principle settlement at Grasshopper River at Ozawkie. Claims were selected, but lands were to be sold to the highest bidder at a later date. This was the beginning of open warfare between pro-slavery and free-staters. Lawlessness prevailed.
1856	Crosby began a store at Grasshopper Falls. The town was sacked by ruffians.
May 21, 1856	Sacking of Lawrence by Pro-slavery men. General Lane then raised "army of the North" to retaliate.
Sept. 11, 1856	Battle of Slough Creek. Skaggs farm was held by South Carolinians, who were surprised and defeated by Free Staters, led by Colonel Harvey.
Sept. 14, 1856	Battle of Hickory Point, called "even." (Note: John Steuart Curry, artist, was born and reared near Hickory Point.)
Nov. 1856	Sale by auction of the northeast portion of the Delaware Reserve at Leavenworth. Squatters' rights, the only claim settlers had to land prior to land sale, were the source of many troubles. At first, habitation had been required, but later only a foundation was required. This reduced requirement was abused by speculators.

July, 1857	Warfare had subsided. The sale of the western portion of the Delaware Reserve took place by auction at Ozawkie. Three-quarters of the claims were sold to speculators at enormous prices. A financial crash followed. Many settlers left the area, and deserted their cabins. Immigrants began to pour in. Ozawkie and Grasshopper Falls were the two places of greatest attraction.
1858	As the result of a ballot vote, the county seat was moved from Ozawkie to Oskaloosa. The U.S. Government sold the land now used by U.S.D. 501 to Charles Jones.
1860	Drouth! Starvation! People were aided by societies from the East.
	The final treaty governing the lands held by the Delaware nation was signed. The balance of Jefferson County went to the Leavenworth, Pawnee, and Western Railroad, which was to build a road through the territory before acquiring title. The Delaware each received grants of their own selection of 80 acres for each tribe member, and chiefs received larger grants of 320 acres. Many sold out to the white man.
1863	Quantrill's raid on Lawrence gave impulse to vengeance by "jayhawkers," organized by Jim Lane. In the beginning, they did effective work in stopping rebels in Missouri, but they soon degenerated into common thieves. Jefferson County was full of jayhawkers, until the death of Bill Blake, one of their leaders.
1864	The legislature, pressured by railroad lobbying, passed an act making the Kaw an unnavigable stream and permitted the building of dams and bridges. This ended the twelve year steam boat era on the River, when thirty-five steamboats operated on the Kaw. Ferry boating had been important before this act also.
1864-1865	During the Civil War, many men were in the army or state militia and little growth occurred in the area. After the war, immigration and prosperity began again.
1866	Conflict between the railroads and settlers occurred. The railroad sold settlers' land to a milling company, whose men destroyed homes. The settlers fought back by driving nails into saw logs, and fought a gun battle.
1867	The last of the Delaware moved from the area to the Indian Agency at Wichita and later to Indian territory among the Cherokee.
1868	Charles Jones sold camp site to Matthew Malone.
1871	Kansa Central Railroad, a narrow gauge road, had a train going, leading to the peak of railroad fever by 1887.
1872	Floods!
1874	Grasshoppers - in "clouds to keep out the sun." In three days all the fields were destroyed. Grasshoppers laid eggs.
1875	More grasshoppers! Even worse. Many people left the state.

1876	Matthew Malone borrowed $1000 from Timothy B. Sweet, prominent Topeka banker, to keep going during this difficult time.
1888	First "petticoat government" in America at Oskaloosa was elected. They accomplished a Sunday closing act, new sidewalks, and a curfew law.
1891	Malone sold to Molly Malone and Arabella Palmer.
1900	To William Sayles.
to	Oil and gas leases.
1946	To Nathan Isaacs.
1956	Isaacs to Murray.
1962	Murray to Griffitts.
1963	Griffitts to U.S. Government, $45,000/400 acres.
1972	U.S. Government leasing to U.S.D. 501 for Outdoor Education Laboratory.
Sources:	A. T. Andreas, History of Kansas (Chicago, 1883) Kansas Anthropological Association Newsletter, Vol. 14, #1, September 8. Transactions of the Kansas Academy of Science, "Mounds in Perry Reservoir." "The First Hundred Years of Jefferson County," Centennial Celebration Publication, William Leech, Chairman.

APPENDIX H

(Special Teacher Reference)

The material contained in Appendix H is included as a special reference for teachers desiring more information about some of the Kansas animals. This material should be used in any way the teacher finds useful.

Copperheads H-1

Kansas Mammals H-8

Kansas Birds H-12

Kansas Fish H-16

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COPPERHEADS

This article taken from the Kansas Fish and Game publication of March-April 1972 - Vic McLeran author - is not intended to alarm you or your students. It is intended to alert you and them to the fact that any time one ventures into the open spaces in Eastern Kansas in the fall, spring or summer, he might be trespassing on the homeland of a copperhead. I believe this article will be quite interesting to your students as it is an opportunity for them to learn facts that might prevent an injury in the future.

We need to educate our youngsters that snakes have an important part in the balance of nature.

C. L. Kellogg, Director
Outdoor Education

COPPERHEAD

(Story by Vic McLeran)

Something was wrong!

From her nest in the wild grapevine, the brown thrasher fluttered down with quick, nervous wingbeats, obviously upset. Upon alighting, she began circling in a strange, erratic manner. With wings and tail drooping, she made short, choppy hops, darting forward occasionally to peck sharply at something in the tall grass.

From a nearby blackberry thicket, I watched the thrasher's curious antics for several moments, puzzled by her behavior. Then I saw it--a coppery blur in the grass as something lashed out toward the bird with astonishing speed.

Curious, I moved in to investigate. When I was several feet away, the bird flew and I then saw the object of her concern.

There in the dew-covered grass lay a copperhead, coiled and ready! Shafts of light from the early morning sun struck the reptile obliquely, making its rich, coppery pattern contrast sharply with the emerald foliage. The snake's ominous, wedge-shaped head was tilted back and the deadly jaws were open wide. The reptile's cat-like eyes followed my every move. For what seemed like an eternity, the snake remained coiled in its threatening position with fangs erect. Then slowly and cautiously, the reptile began slithering away, pausing occasionally to check the air with its forked tongue. Soon the copperhead was lost from view in the dense foliage.

What I had just witnessed was one of Nature's little dramas. Since songbirds recognize snakes as natural enemies, they usually harass the reptiles on sight or attempt to lure them from the area, especially if the snake is near the bird's nest.

Agkistrodon contortrix, as the copperhead is known scientifically, is probably the most common poisonous snake in eastern Kansas, and the one which outdoorsmen in that part of the state are most likely to encounter.

Range, Distribution and Habitat

The copperhead ranges throughout the southeastern quarter of the United States. In Kansas, the copperhead is found mainly in the eastern third of the state, although it has been recorded as far west as Winfield in Cowley County.

Throughout its range, the species tends to associate itself with wooded rather than prairie habitat. It prefers ground which is shaded by foliage and covered with leaf litter. Copperheads are also fond of moist areas such as marshy glades, swampy brush and low-lying habitat like creek or river bottom timber. Then too, the species utilizes rocky ridges and ledges. Most moderately-wooded areas in eastern Kansas which contain moist and rocky habitat will probably harbor a copperhead population.

Physical Description

Garbed in various shades of coppery-brown, the copperhead generally exhibits a series of alternating light and dark crossbands on its skin. This series of dark brown hourglass bands and the lighter tan-colored saddle markings allow the reptile to blend smoothly with its surroundings. These camouflaged markings are so effective the copperhead is almost impossible to spot against a leaf-littered forest floor.

Dr. Robert Clarke, herpetologist and professor of biology at Emporia State Teachers College, cites a fairly typical situation which illustrates this camouflage ability. "I was on a collecting trip early one fall in Osage County when I noticed a copperhead lying several feet in front of me. I stepped back and began adjusting the noose which I use in capturing the reptiles. While doing so, I began looking closely at the leaf-covered ground. To my surprise, I counted five more copperheads in the immediate area, including one on which I was standing! The reptile made no attempt to strike but simply remained coiled beneath my boot. The snake was almost impossible to see there in the leaves."

"Chunkhead," as the copperhead is nick-named in some areas, is an apt description due to the reptile's stubby or chunky appearance. Copperheads average 22 to 36 inches in length with the male about one-fourth larger than the female. From time to time, one reads about copperheads of monstrous six to seven foot proportions being killed. However, the largest copperhead on record was a 53 inch specimen captured near White Plains, New York. Most Kansas copperheads fall within the two to three foot range.

Venom and Fangs

Since snakes swallow their food whole and don't chew it, their venom contains powerful enzymes which assist digestion. Yellowish in color copperhead venom contains several protein poisons which attack blood cells, blood vessels and the central nervous system of the victim. Interestingly, copperhead venom has been used medically as a blood coagulant and in the treatment of eqilepsy.

Copperhead venom, when compared with that of its close relative, the cottonmouth water moccasin, and various rattlesnakes, is much less potent. In fact, most rattlesnake venoms are from two to six times more potent than copperhead venom.

Mating and Young

Although mating may occur anytime during the copperhead's active season, most copulation seems to take place right after the snakes come out of hibernation - usually during April or May in Kansas.

Like most members of the viper family, copperheads don't lay eggs but instead, give birth to live young. The five or six young copperheads are usually born in the early fall months from August through October. There's some evidence female copperheads can store the male's sperm and delay fertilization for months or even years. An adult female copperhead was taken from Texas and sent to a Pittsburg zoo in July, 1954. A year later she gave birth to a litter of five. During the interim, she had no contact with male copperheads. The advantage to this prolonged sperm life is obvious - especially in areas where the copperhead population is small.

At birth, copperheads closely resemble the adult snakes except for a couple of details. The end of the juveniles' tail is greenish-yellow on the bottom. This distinctive coloration apparently serves a purpose for the young vipers - that of luring prey within striking distance! The late Dr. Raymond Ditmars, world-famous herpetologist wrote, "Quite frequently, when food is introduced into a cage containing small copperheads, the tails of the little snakes wriggle and twist in a manner that instantly suggests their remarkable similarity to yellow grubs or maggots." Copperhead prey items like frogs and small snakes which normally feed on grubs and maggots evidently spot the wriggling tail, mistake it for an easy meal, move in to take advantage and zap - it's all over!

In the past there's been some difference of opinion regarding the newborn copperhead's ability to produce venom and deliver an effective bite. But there's no limit to what some researchers will do to establish scientific facts. To prove young copperheads are born with a venom supply and an effective bite, one scientist allowed a newborn copperhead to bite his forearm for 60 seconds. He proved it! In fact, reaction was so severe that his arm swelled steadily for the next 21 hours. Evidently though, the scientist's dedication diminished because in future experiments he used mice instead of his arm. For the most part, it's now believed newborn copperheads possess effective venom.

Hunting Ability

The copperhead hunts like a cat. It combines long periods of motionless watching with shorter intervals of stealthy prowling and culminates the hunt with a quick strike. Copperheads, like several other poisonous snakes, possess an unusual heat-detecting apparatus called the facial pit. This organ, which is sensitive to body temperatures, allows the copperhead to detect the presence and position of warm-blooded mammals, even in total darkness. This device takes the form of a small depression or "pit" directly in front of and below the snake's eye.

Once having located prey, the copperhead's actions from that point vary according to the size of the intended victim. On small food items like insects, lizards and birds, the snake usually strikes with a lightning-like jab and holds on until the victim succumbs. On larger, stronger prey which is able to resist vigorously, the snake strikes, injects its venom and releases, allowing the poison to do its job. The strike itself is usually delivered as a short jab, often traveling less than six inches, even for a two or three foot copperhead.

Food Items

Dr. Henry S. Fitch, director of the Kansas University Natural History Reservation, has studied copperheads extensively. His publication, "Autecology of the Copperhead," is probably the most comprehensive work in the world on his species. During a 15 year study on the species, Dr. Fitch who literally lived with these snakes compiled the following list of prey items for Kansas copperheads: prairie voles, cicadas, white-footed mice, short-tailed shrews, ring-necked snakes, five-lines skinks, brown skinks, caterpillars, pine voles, harvest mice, toads, leopard frogs, lizards, cotton rats, worm snake, house mice, garter snakes, wood rats, cottontails, Dekay's snakes, box turtles and rarely, small birds.

Copperheads, like most snakes, gorge themselves on one meal and then often go weeks before eating again. One large copperhead found near Arkansas City had eaten a goldfinch, a small box turtle, two voles and a racer snake. Dr. Fitch estimates the typical Kansas copperhead consumes eight meals totaling approximately twice its weight during a growing season which extends from April or May when the reptiles come out of their hibernation dens to October when they return for the winter.

Natural Enemies

The copperhead, with its venomous armament, would appear safe from most woodland predators. And for the most part this is true since the majority of predators seem to have an instinctive fear of poisonous reptiles. However, there are exceptions.

Dr. Fitch found that in the area around Lawrence, copperheads were a common prey item of red-tailed hawks. Although hawks are active during the day and copperheads are nocturnal, their activity overlaps during the twilight periods. The actual attack hasn't been witnessed, but the hawk probably swoops down unseen by the snake and secures a death grip on the reptile's head or neck.

The great horned owl, that old woodland toughy, also preys occasionally on copperheads. Dr. Fitch described one such encounter saying, "After grabbing the snake, the owl carried it a short distance. During this short flight, the copperhead struck the owl one or more times on the thigh. The owl uttered scolding sounds and dropped the snake. Almost immediately the owl showed signs of distress and ceasing its usual activities, perched quietly, shifting position from time to time. After several hours an oozing substance was noted on the owl's thigh and a small pool of blood collected where the bird was perched. Approximately eight hours after being bitten, the owl suddenly collapsed and died!"

There exists in Nature, a curious phenomenon where certain animals, ordinarily thought of as prey species, occasionally become aggressive, preying on other species viewed mainly as high level predators. A case in point is the mole-bullfrog-copperhead relationship. Ordinarily, moles and frogs are considered prey items often included in the copperhead's diet. Occasionally though, the tables are turned. Dr. Fitch twice placed young copperheads in a terrarium containing two moles. Each time, the snakes were immediately attacked by the moles, dragged underground and eaten.

Joseph T. Collins, herpetologist and vertebrate preparator at the University of Kansas Natural History Museum, observed some aggressive bullfrogs capturing and swallowing copperheads.

"For study purposes, I was releasing a brood of several young copperheads along the edge of a pond," Collins said. "The snakes were about three weeks old and had been born in captivity. Upon being released three of the young snakes swam toward the middle of the pond. I then noticed several large bullfrogs resting along the pond's edge. As soon as the frogs spotted the snakes, they swam vigorously toward the young reptiles. Upon reaching the copperheads, each frog grabbed a snake and swallowed it whole."

Along these same lines, rodents, normally thought of a prey species, can become aggressive and attack venomous reptiles. Collins, in charge of the Museum's collection of snakes, described this unusual situation. "When feeding mice to our captive snakes, we make sure the rodent is well-fed before being placed in the snake's compartment. We also have to be sure the snake is ready to feed. If the reptile isn't hungry, it simply ignores the rodent, and a hungry mouse will often start chewing on the snake. When this happens, some snakes become aggressive and strike the rodent while others merely thrash about trying to escape. The reaction varies with individual snakes," Collins said, "but we've had both copperheads and rattlesnakes die as the result of attacks by hungry rodents."

Dr. Fitch says there is some indication this predation occurs in a natural state with mice and shrews feeding on hibernating snakes. Being sluggish and defenseless during hibernation, the reptiles are simply viewed as "meat in cold storage," by hungry rodents.

In addition to those who kill snakes simply because they're snakes, some people hunt reptiles for food. People who have eaten it, say copperhead meat, like that of the rattlesnake, is tasty.

The king snake, with an immunity to most snake venom, has no qualms about dining on an occasional copperhead. In a Louisiana study, 17 copperheads were found among the stomach contents of 301 king snakes. Gary K. Clarke, director of the Topeka Zoological Park, once witnessed an encounter between the two.

"I was working for the Kansas City Zoo at the time," Clarke said. "We had an eastern king snake which got into a compartment that contained a large copperhead. Upon spotting the king snake, the copperhead coiled immediately. As the king moved in, the copperhead struck five or six times. But once the king got its coil around the copperhead, it was all over and the king snake eventually swallowed the viper."

"You'll never find snakes around a hog pen," is a common saying in the South. It's true to some degree, since hogs will eat snakes - both poisonous and nonpoisonous species. Although swine are not immune to snake venom, their thick skin and heavy layer of fat are thought to retard absorption of the venom.

The copperhead's life span is thought to average seven or eight years under natural conditions. In zoos, where life is much easier, copperheads have been recorded as reaching 18 years of age.

Controlling Copperheads

The public's attitude toward snakes, particularly poisonous snakes, has long been one of fear and misunderstanding. Ophidiophobia, the extreme fear of snakes, was once so prevalent in Connecticut that the state placed a bounty on copperheads. For the most part, this fearful attitude is unjustified, since snakes would rather flee than fight. Then too, they perform a useful function of eradicating rodent and insect pests. For this reason, snakes should be left alone when encountered away from areas of human activity.

However, in areas where people are likely to encounter venomous snakes, control measures may be feasible. Outdoor recreation areas like children's play grounds, campgrounds, public parks, and picnic spots may need control measures if copperheads are present. People living in farm houses or lakeside cabins also may want to remove copperheads from the immediate vicinity.

Although there is no method of eliminating snakes completely, it's possible to discourage them by destroying their habitat and food supply. Piles of old boards, slabs of roofing paper, rock piles, dump heaps, corrugated iron sheeting, discarded burlap bags, cardboard cartons, brush piles and similar areas provide hiding places for snakes and their prey items like rodents and insects. Ridding the premises of these hiding places will invariably reduce both snake and pest populations. Cautious and discriminate use of a pesticide can further reduce rodent and insect populations.

Snakebite

Volumes have been written regarding various treatment for snakebite, and there is still a great deal of controversy over each method. Since there are many variables associated with each snakebite, no single form of first aid is always best. Persons who are bitten should attempt to remove the venom by sucking the wound, remain as calm as possible and seek immediate medical help. Whisky and other stimulants should be avoided as they stimulate circulation and quicken the action of the venom.

Bear in mind that the vast majority of persons bitten by copperheads recover. An adult in good health is almost always assured of total recovery. Persons in poor health and children are another matter. Former Vice-President Alben Barkley's career was almost terminated at the age of six when he was bitten by a copperhead as he crawled under the family cabin after a chicken.

Although copperheads account for the largest number of snakebites in the United States, their bite is rarely fatal because of the relatively weak venom. After a review of the literature and statistics, Clifford Pope, eminent herpetologist, concluded that five species of snakes were responsible for 95 per cent of all snakebite deaths in this country. The copperhead was not among these five.

Precautionary Measures

That old saying, "an ounce of prevention is worth a pound of cure," is probably never more true than when dealing with venomous reptiles. Avoiding snakebite is obviously preferable to treating it.

Outdoorsmen in eastern Kansas, by the very nature of their activities, are often in close proximity to copperheads. Hunters and trappers, who are afield mainly during cold weather, don't have too much contact with snakes, since the reptiles hibernate during fall and winter months. On the other hand, fishermen, mushroom hunters, campers, hikers, frog hunters, picnickers and others, who are engaged in outdoor activities during warm weather, run a greater chance of encountering snakes.

Fishermen and boaters should be especially careful when moving boats left on shore for several hours. Copperheads often hunt near the water, and boats resting half in and half out of the water provide excellent cover for reptiles.

Campers and picnickers, when gathering wood for a fire, should be particularly observant and fuel should be gathered while there is still enough light to see. When camping, sleep as high as possible off the ground. If this is impractical, and you have to sleep on the ground, avoid areas containing heavy undergrowth and brush or rock piles. Since many camping trips involve children, the kids should be shown color photos of the copperhead and instructed to tell their parents if they see any similarly marked reptiles.

Copperheads tend to be nocturnal, especially during hot summer months. Also, they're fond of frogs. Accordingly, frog hunters should wear hip waders when working streamside vegetation and scan the area carefully before moving in to grab their frog.

Mushroom hunters are often abroad in prime copperhead country during April and May. Before you stoop to pick a mess of morels, check the surrounding leaf litter. It might harbor a well-camouflaged copperhead.

When climbing hillsides or rocky areas where copperheads may occur, be watchful of where you place your hands and feet. Hikers traveling through copperhead country, should wear hightop leather boots. When hiking, don't simply step over logs, step on top of them and look before stepping down.

The best defense against snakebite is an ability to recognize poisonous species, coupled with some knowledge of the reptile's habitat. Bear in mind that poisonous snakes, regardless of what you've heard, are not truly aggressive. They would rather remain concealed or crawl away quietly than risk an encounter. However, if they're disturbed, either accidently or intentionally, they'll strike.

KANSAS MAMMALS

What are mammals? They are animals that have hair and feed milk to their young. Typical mammals are the coyote, the skunk, and the squirrel. Mammals are commonly called "animals." The term "animal" actually includes the birds, the reptiles, the fish, amphibians and other living creatures that are not classified as plants.

We have many unusual mammals in our state. Their habits are varied and interesting. The opossum is our only native mammal that carries its young in a pouch. The bat is an expert flyer. He can outfly most birds. The so-called flying squirrel does not fly. He sails through the air like a glider. The mole spends most of his life underground, and he has no external eyes. The tiny shrew is a ferocious fighter. He is also our smallest mammal, scarcely larger than a man's thumb. He is capable of killing mice twice his size. The huge bison or buffalo and the elk that once roamed Kansas can now be seen only in zoos or on refuges.

Mammals can be grouped according to their feeding habits. Those like the coyote, the fox, and the bobcat eat meat. They are called "carnivorous" mammals. Rabbits and mice eat plant food such as grass, fruit, nuts and leaves. They are "herbivorous." The opossum and raccoon eat both meat and plants. They are called "omnivorous."

Generally speaking, meat-eating mammals are called predators because they prey on or kill other animals. The predatory mammals sometimes kill our chickens and other livestock. This does not mean that they should be destroyed. When a coyote kills and eats a chicken he is harmful to us. When he kills and eats a dozen rats and mice he is our friend because rats and mice destroy our grain and other foodstuffs. We must be careful in separating our friends from our foes in the wild animal world. The best policy is to judge each wild animal as an individual rather than a group. When one man commits a crime, we do not judge all men as criminals. We must give our wildlife the same fair judgment by controlling only the individuals that are actually known to do us harm.

It is the nature of man to place a value in terms of money on each thing he comes in contact with. We are asked, "What is the value of wild mammals?" Game mammals, such as the rabbit and the squirrel, provide us with sport and recreation and are also a source of food. Fur-bearing mammals such as the mink, muskrat and the skunk provide us with an income from their hides and furs. We get great enjoyment just by looking at and talking about mammals and other kinds of wildlife. We have no way of measuring this value in terms of cash.

Both mammals and other wildlife forms are widely used as subjects in books, motion pictures, and even in advertising campaigns by our country's leading manufacturing concerns. We could not live happily without mammals. That is one reason why we have conservation. We must manage our soil and waters wisely so that our mammals and other wildlife, as well as ourselves, will not perish from the earth.

Mammals You May See

Opossum--The opossum is found generally throughout Kansas. He makes his home in hollow trees, in burrows in the ground, in crevices or caves along rocky bluffs, in brushpiles, and even in building in towns. We do not see him very often because, like most of our mammals, he sleeps in the daytime and roams around only at night.

The opossum is the only marsupial in North America. Marsupials are mammals that have pouches for carrying and protecting their young. The baby opossums are blind and naked and are not much larger than a bean when born. They live inside their mother's pouch for about two months. Then, too big to fit in the pouch, they accompany their mother through the woods by riding on her back.

When frightened by a dog, or man, or a wild animal larger than he is, the opossum often "plays dead." Some people think he does this to fool his enemies. Others contend that he is just scared so bad that he faints. We think he faints. When he plays dead, he's not fooling anyone because that is just what his enemies want, a "dead" opossum to eat!

The opossum is the only mammal native to North America that can hang by his tail. When hungry, he eats a great variety of plant and animal food. He likes to eat persimmons, all kinds of fruit, green corn, birds' eggs, insects, mice and rats, frogs, birds, and dead animals of any kind. If an opossum lives in your neighborhood, he will raid your garbage can when the lid is left off.

Raccoon--The raccoon is one of our most popular mammals. He lives wherever water and woods are found in Kansas. His home is a den in a hollow tree, a rocky cave, a hollow log or a burrow in the ground. We should not cut down old hollow trees. When we do, we destroy the raccoon's favorite home.

The raccoon is a handsome and intelligent mammal. He uses his forepaws almost as well as we use our hands. When he is near water, he goes through the motions of "washing" his food before eating. Apparently it isn't to wash the food because he scrubs it with his paws the same way on dry land.

The raccoon's babies are born in April. They usually number from three to six per litter. Young raccoons are easily tamed. They make playful and clever pets. For this reason many people kidnap them from their wild home. This is against the law in our state.

Chasing raccoons at night with hound dogs is a favorite sport in many sections of Kansas. The raccoon is an expert tree climber. He escapes the dogs by climbing a tree. The raccoon used to be an important furbearer. He is not as profitable as a fur mammal now as he was in former years. He is still as good to eat as he ever was.

Striped Skunk--The striped skunk is found everywhere in Kansas. He is well known for his powerful scent. Skunk scent is a clear yellow fluid. He can spray it either in a fine mist or a steady stream from two muscular sacs or glands just inside the anal opening. Skunk spray is very painful to the eyes of other animals and man. It will not cause blindness as some people think. The skunk will always bluff first, if he can. He apparently knows that he is limited to five or six shots at any one time. It takes him a little while to reload. He knows that it would be dangerous for him to walk around the woods without his smelly ammunition.

Insects are very important skunk food. Grasshoppers, beetles, crickets, grub worms and many other kinds of insects and their larvae are T-bone steaks to the skunk. He also eats all kinds of berries and fruit, mice, gophers, moles, fish, birds and their eggs and even turtle eggs.

Young skunks are born naked and blind in a den underground. Their black and white pattern shows plainly through their bare skin. At about seven weeks of age they follow their mother single file through the woods and fields in search of food. There may be from three to eight "little stinkers" to a family. The little fellows can spray too.

Coyote--The coyote resembles a collie dog, but is considerably smaller. The male coyote is a devoted father. He helps the mother coyote feed the puppies. He assists in teaching them how to hunt mice and other food and how to care for themselves in the wild. This is no small job when you consider what large families coyotes have. One mother coyote was known to have whelped 19 pups. The average litter is five or six. The pups are born either in a burrow that the parent coyotes dig themselves or in a natural cave, a hollow log or a shelter under a rock pile.

A coyote will eat almost anything that is digestible and sometimes stuff that isn't. Many people think that all it eats is the farmer's chickens and other livestock. This is not true. Over half of its food the year around consists of rodents such as rabbits, rats, mice, ground squirrels and gophers. Other well known coyote foods are birds, snakes, berries and fruits, and any dead animal that it happens to find. Coyotes are not a threat to game birds.

Crosses between the domestic dog and the coyote are common. These mixed breed individuals often cause more harm to livestock than full-blooded coyotes. The hybrids may resemble either the dog or coyote. The coyote is commonly called "wolf." Real wolves are much larger. Despite many years of control, coyotes are still plentiful. The coyote is found all over Kansas.

Red Fox--The red fox in prime fur is one of our prettiest mammals. Foxes often are accused of eating quail and chickens. In most cases they are condemned without evidence or trial. Actually they seldom kill quail, and they normally prefer a meal of rats and mice to one of chicken. Foxes also eat many insects, such as grasshoppers, crickets and beetles. They are also fond of all kinds of berries and fruit and will eat such things as turtles, tadpoles, frogs, earthworms, clay dirt, grass and carrion.

A full grown red fox rarely weighs more than ten pounds. The average is between five and ten. Foxes are not very strong and are poor fighters. A full grown house cat is much stronger and more vicious. The red fox depends on his cleverness and keen wits to escape his enemies.

Not a very good digger, the red fox prefers to use the burrow of some other animal for his den. The mother fox also utilizes crevices in rock ledges and sometimes hollow trees or logs as a nursery for her young. The baby foxes are playful and lively little fellows. There may be from three to nine of them to a family.

Muskrat--The muskrat is one of the most useful of our furbearing mammals. His fur ranks tops in the fur markets because it is the most plentiful. Muskrat meat is fine-grained and tender and is good eating. It is sold and served to the public as a "marsh rabbit" in many large eastern cities and the states of Louisiana and Texas. Full grown muskrats weigh from two to four pounds.

The muskrat lives in Kansas wherever there is suitable water. He digs a tunnel into the bank of a stream, lake or pond to make his home. The entrance is under water and the den usually has two or three rooms. The muskrat may raise from three to five litters of young each year. The average is four or five, but there may be as many as thirteen muskrat babies to a family.

The muskrat is an excellent swimmer. While his outer fur gets wet in the water his dense inner fur keeps him warm and dry. He swims by paddling with his hind feet and folding his front feet up against his chest. His tail, which is flattened vertically, is used as a rudder to guide him in the water.

Muskrats feed on all kinds of vegetable matter such as leaves, stems, roots, bulbs, and seeds of water plants. They are fond of corn. They also eat fish, mussels, frogs, tadpoles, and have been known to eat each other during hard times.

Rabbits--Two kinds of rabbits live in Kansas. They are the jack rabbit and the cottontail.

The jack rabbit is found in prairie areas throughout the state. Young jack rabbits are born with a full coat of fur and with their eyes open. Two or three babies form the average brood. When pursued by his enemies, the jack rabbit can run as fast as 45 miles per hour. He easily makes 15-foot broad jumps. He is also a good high jumper. While 2 1/2-foot high leaps are everyday affairs, jack rabbits have been known to have jumped over fences 5 1/2 feet high. A full grown jack rabbit will weigh from four to seven pounds.

The cottontail is found everywhere is Kansas. It lives in a variety of habitats, from grassy fields to brushy woods. Baby cottontails are born blind and naked in a hollowed-out nest on the ground. The nest is lined with grasses and a quantity of the mother cottontail's hair. The average number of babies per brood is four to six. As many as four broods may be raised each season. The life of a cottontail is short. Studies by naturalists reveal that one out of 20 lives to be one year old. Man is the cottontail's worst enemy, and dogs, cats, coyotes, mink, owls, hawks, snakes and other meat-eating animals are always trying to catch him. The cottontail averages two to three pounds in weight.

Squirrels--The three squirrels common to Kansas are the fox squirrel, the gray squirrel and the flying squirrel.

The fox squirrel is the largest. He averages about two pounds in weight, although extra large individuals may weigh as much as three pounds. The fox squirrel lives in the open woodlands. He is most common in the eastern half of Kansas, but is also found scattered throughout the western portions.

The fox squirrel spends more time on the ground than the other tree squirrels. He becomes tame and friendly in public parks and often begs for peanuts and other edibles. His natural wild food consists of acorns, hickory nuts, pecans, walnuts and all kinds of tree seeds. He also feeds on buds of several kinds of trees, wild fruits, corn, insects and mushrooms.

Squirrels are born hoarders. Some have a cache of nuts in a hollow tree. Others store away hundreds upon hundreds of all kinds of nuts by burying them individually in the ground. Sometimes months later, the squirrel finds them again by using his keen sense of smell. Nuts that are not found sprout into trees. It is not too far-fetched to say that the squirrel "grows his own home," or at least he helps. Baby fox squirrels are born naked and helpless in a hollow tree or leaf nest. The usual litter numbers from three to five. Many people enjoy watching squirrels. Squirrels provide us with good sport hunting and they are excellent eating. We would have more squirrels if we would not cut down their den trees.

The gray squirrel is smaller than the fox squirrel. One to 1 1/2 pounds is his average weight. The gray squirrel is often called "cat" squirrel. His home is in the dense, hilly woods and rocky ledges of eastern Kansas. He eats the same food as the fox squirrel and his habits are similar. Gray squirrels sometimes raise two broods of young per season.

The flying squirrel cannot fly. He sails through the air like a glider. He guides himself with his flattened tail. Flying squirrels are active only at night. That is why we seldom see them. The flying squirrel is small and delicate, more mouse-like than the other squirrels.

KANSAS BIRDS

Birds are perhaps our most popular wild creatures. Their pretty feathers and cheery songs never fail to attract our attention. Since time began, man has envied the flying ability of birds. Today's modern aviation had its beginning from ideas gained by men who studied the flight of birds.

Birds are important to our welfare in many ways. Their body temperature is higher than other animals - about 110 degrees. It takes large quantities of food to keep them going. Insect-eating birds eat several times their own weight in food each day. No one knows exactly how important birds are to our agricultural economy. One student of birds attempted to figure it by estimating that if it weren't for the birds, the earth would be a barren desert in just seven years. The bugs, worms, mice and rats would eat everything and man would starve.

Birds have specialized feeding habits. Some prey entirely on insects, some on mice and rats, some on fish. Some birds are scavengers, ridding our fields of undesirable carrion. Some eat vast amounts of noxious weed seeds. When we misuse the land and soil, drain swamps, pollute our streams, we upset nature's scheme of things. The birds and other animals suffer. When an unwisely managed area is rendered uninhabitable for them, they die or move to more suitable surroundings.

In order to live, birds must have a good supply of food, suitable cover to build their nests and rear their young, and dense, brushy places to hide from their enemies. A healthy land supplies all these things. By practicing sound conservation of our soil and water and other natural resources, we can keep the birds with us.

We, as Kansans, can take pride in the large number of birds that live in our state. More than 446 different kinds have been listed for Kansas. Located in the center of the United States, we get a mixture of both eastern and western birds, as well as those that are typically midwestern species.

We have birds in Kansas the year around. For easy classification, they can be divided into the season of the year they are with us. Permanent resident birds are those that are found in Kansas throughout the year from January to December. Typical permanent residents are the crow, the bobwhite quail and the meadowlark. Summer residents are birds that are with us during the warm months, chiefly from April to September. Typical summer residents are the green heron, the kingbird and the orioles. Winter residents are birds that live in our state during the fall and winter, chiefly from October to April. Typical winter residents are the mallard duck and the tree sparrow.

Some birds are found in Kansas only during the periods of spring and fall migrations. The spring migration takes place from late February to early May. The fall migratory flights occur from September to December. Typical migrant birds are the Canada goose, the Franklin's gull and the Wilson's warbler.

Certain game birds, such as quail and pheasants, are protected by state law. It is illegal to kill them except during open hunting seasons. Migratory game birds such as ducks, geese, coots and doves are protected both by state and federal laws. They may be killed only during legal open season. Federal laws also protect all song and insectivorous birds. English sparrows, crows, starlings, some hawks, one owl, blackbirds and bluejays are the only birds that are not protected by law in Kansas.

Birds You May See

Bobwhite Quail--The bobwhite is among the most important wild birds in our state. "Bob" is useful in many ways. Found in every county in Kansas, the bobwhite is eagerly sought after by sportsmen during the fall hunting season. The business of hunting the bobwhite is an important factor in our state's economy. Thousands upon thousands of dollars are spent each year for hunting equipment, gasoline, provisions and lodging by the sportsmen who enjoy a trip afield to hunt quail.

To hunters and non-hunters alike, the bobwhite is a handsome, cheery bit of feathers. He is a friend of man who helps rid the farmer's fields of harmful insects and weed seeds. His well-known whistle "bob, bob white" is known and loved by everyone.

Papa Bobwhite is just as much a homebody as his wife. He concernedly assists in hatching and rearing the baby quail. Bachelor bobwhites have been known to adopt orphan chicks and tend them as carefully as if they were their own. Quail nests are hidden in the grass or other vegetation on the ground. Ten to eighteen eggs form a clutch. Newly hatched baby quail are about the size of a man's thumb. They are downy and follow their parents like young domestic chickens.

In the fall and winter the bobwhite gather into small flocks called "coveys." They sleep together on the ground, in a circle, tails to the center, heads pointing out. Disturbed by an enemy, they take flight explosively in every direction. This usually startles the intruder so much that before he can collect his wits the quail have made their escape.

The Kansas Forestry, Fish and Game Commission operates two quail farms that produce yearly 25,000 to 30,000 quail for release in the wild.

Hawks--If you want to start an argument, bring up the subject of hawks. "The only good hawks are dead hawks" is a familiar saying. It is a shame that people still persist in condemning the hawks in Kansas. Our state has passed laws protecting all but three of them. Out of the 17 kinds found in the state only three can be counted as truly bad. They are the crow-sized Cooper's hawk, the smaller sharp-shinned hawk and rarely the goshawk. All other hawks are more or less beneficial birds. True they may once in a while pounce on a chicken, or even more rarely a game bird, but the number of rat and mouse pests they destroy far out-weighs their misdeeds.

The next time you see a hawk making circles in the sky or sitting majestically atop a lone tree in the pasture, hold back that urge to destroy it. If he dives into your chicken yard or captures a game bird (which is rarer than you think), go after him. Otherwise, be thankful with the thought that he is your friend in the battle for survival.

The red-tailed hawk is one of the common hawks. His brick-red tail makes him easy to identify. Tails of young birds are gray, barred with black. A large red-tail will have a wingspread of over 4 1/2 feet. In flight, he is a heavy-set, broad-winged fantailed hawk. He is often seen soaring and wheeling in circles in the sky over the wood's edges. When perched, he chooses a telephone pole, a lone snag of a dead tree, or a fence post. The red-tailed hawk is a beneficial hawk.

Some individuals occasionally prey on chickens and game birds. When caught in the act, they should be destroyed. Naturalists who have made studies of the red-tail's food habits have found that fully 66 per cent of its food is injurious rats and mice. Poultry and game amounted to only seven per cent. You can see that his common name, "hen hawk," is wrongfully applied. He really should be called "mouse or rat hawk."

The Swainson's hawk is a common hawk of the dry prairie country of western Kansas. He is one of our most beneficial and useful hawks. Swainson's hawks seldom prey on birds of any kind. One Swainson's hawk will eat hundreds of harmful rodents each year. Yet many of our Kansas ranchers thoughtlessly continue to shoot them on sight.

The marsh hawk is the long-winged, long-tailed hawk that we see flying low to the ground over the prairies of Kansas. The male marsh hawk is gray. The female is brown. They occasionally capture a game bird or a chicken, but the heavy toll they take of the mouse and rat populations more than overcomes the bad they do. While most hawks nest high in the trees, the mother marsh hawk raises her babies in a nest on the ground.

The Cooper's hawk is the true black sheep of the hawk family. His misdeeds have caused the wrath of man to be leveled at the entire hawk family. Birds are his main food. He has been known to inflict heavy losses among the flocks of poultry raisers. He is a threat to game birds. Many people call the Cooper's hawk the "blue darter." He lives in the deep woods where he slips through the trees so cleverly that he is seldom seen. Innocent, beneficial hawks, because of their habit of living in the open, usually fall victim to the gun of the angry farmer whose chickens have been stolen by the Cooper's hawk.

Owls--Nature works around the clock to keep the rat and mouse populations from getting too large. That's how important she thinks rodent control is. When the sun goes down, the hawk goes to bed, and the owl emerges from his sleeping place to take over the job of eating rats, mice and insects.

There are some myths about owls that need to be corrected. Owls can see very well in the daytime. Some, like the short-eared owl and the snowy owl, frequently hunt in broad daylight if they are hungry. You cannot make an owl twist his head off by walking around and around him. With a motion almost too fast for the eye to follow, he will reverse his neck twisting just when you think his head should snap off. Owl's eyes are fixed in their sockets. To see behind them they can turn their heads completely around, without turning their bodies. Symbols of wisdom because of their dignified, wise expression, owls are not rated by naturalists as having an outstanding intellect among the birds.

The great horned owl is our largest owl. He is nearly two feet tall and may have a five-foot wingspread. He gets his name from the horn-like tufts of feathers on his head. He is often heard calling from the woods, "oot-to, hoo-hoo, hoo-hoo," or "wha-hoo, hoo-hoo." Many people call him "hoot" owl. Others call him "cat" owl because his face resembles a cat's. The great horned owl eats all kinds of rodents, such as rats, mice, rabbits and squirrels. He often tackles a skunk. He will also eat poultry, game birds and song birds. Usually he is more beneficial than harmful, but he is the only owl not protected by law in Kansas. He should be controlled only when individual owls are known to be visiting the chicken yard.

The barred owl is our next largest owl. He ends his hooting with a "wah-h." If you hear "hoo-hoo, hoo, hoo-wah-h," you can be fairly certain that it is the barred owl calling. Sometimes two barred owls will get together in the woods and hold a regular gossipy conversation. Barred owls are beneficial birds. They rarely molest chickens or game birds.

The barn owl is our most beneficial owl. His food is almost entirely of rats and mice. Many people call him "monkey-faced" because they think he resembles a monkey. The barn owl likes to build his nest and hide out in barns and old buildings. He does not hoot like other owls. When disturbed, he nods and swings his head back and forth and utters a hissing or blowing noise.

The screech owl is our smallest owl. His call is a trembly, whinny-like note and not a "screech" at all. He has two color phases. Red and gray individuals are found in the same brood of young, regardless of the color of the parents. Because of their small size, screech owls eat more insects than other owls. Mice and small birds are also important items in their diet.

Crow--The crow is considered by many to be the wisest of all birds. For centuries man has attempted to exterminate the crow, but he is still a common bird. He makes the farmers mad because he eats their corn and other crops. Sportsmen dislike him because he eats game bird eggs. These two sins are so great that he gets no credit for the harmful insects he destroys.

Despite his bad habits and the steps we take to control him, we still have a soft spot in our hearts for the crow. In captivity, he makes a mischievous and playful pet. We would miss him if he were gone from our fields and woods. Crow-shooting has developed into a new and popular sport. Decoys, such as dummy and stuffed owls and artificial crow calls, are used to lure the wily crow into shooting range of the hunter's carefully camouflaged blind.

Bluejay--The bluejay is a small cousin of the crow. He, too, has earned himself a bad name by his habit of robbing other bird' nests. He is clever and mischievous like his black relative. Clad in bright blue, he is as pretty as any of our native birds. He has a great variety of call notes and in a clever mimic. His imitations of the cry of the red-shouldered hawk even fools the hawk. By using our imagination, we can interpret his common call as "thief, thief." If he spies you in the woods, his warning call will tell all the wild creatures for a quarter of a mile around of your coming. Bluejays are devoted and dutiful parents. They take extra pains to be quiet around their nest and work very hard to feed and care for their young ones.

Ducks and Geese--More than 25 kinds of ducks and geese are found in Kansas. They are generally divided into two groups, the river or "dabbling" ducks and the sea or "diving" ducks. The "dabbling" ducks do not dive for their food. They tip over, tails up, head down, to feed in shallow water. Typical dabblers are the mallard, the pintail and the teal. The "diving" ducks usually dive deeply under water to secure their food. Typical divers are the scaup duck, the redhead, and the canvasback.

Geese are among the wisest of our wild birds. They are warier than ducks and harder to hunt. They fly in well known V-shaped flocks. Ducks can be distinguished from geese in flight very easily. Geese usually utter honking cries while flying, and their wing beats are slow and easy to see. Ducks generally are silent in flight, and their wing strokes are too fast for the eye to follow.

Common ducks that may be seen are the mallard, the pintail, the baldpate, the green-winged teal and the blue-winged teal.

Common geese that may appear are the big gray Canada goose, the white pink-billed snow goose and the slate-covered, white-headed blue goose.

Mourning Dove--The swift, strong, and erratic flight of the mourning dove makes him the most difficult to hunt of any of our game birds. Expert quail shooters find that it takes careful shooting to bring the dove to bag. The season and regulations on dove hunting are issued each year by the U.S. Fish and Wildlife service.

Doves are the wild relatives of our domestic pigeons. Their nests, which may be located on the ground, in a tree, or on the side of a cliff, are frail platforms of sticks. Old orchards are favorite dove nesting sites. The mourning dove lays two white eggs. Nests with more than two eggs are rare. Young doves or "squabs" are fed "pigeon milk" which is partially digested food pumped or regurgitated from the crop of the parent into the mouth of the young bird. The youngsters stick their bills inside the bills of the old birds to get their meal.

The dove's voice is soft and mournful. He calls "coo-roo, coo-coo" over and over, usually from a perch on a telephone wire or on a dead snag of a tree. Many people call him "turtle" dove.

Eagles--There are two types of eagles, the bald and the golden. The bald eagle is so named because, in its third year, it develops pure white head and neck feathers. Before that, it looks much like the golden eagle, brownish all over. One sure way to tell the difference is to look at the lower joint of the leg. If this is covered with feathers down to the toes, it is a golden eagle; if the leg is naked, it is a bald eagle.

Bald eagles like to live near water because their main food is fish. Their keen eyesight enables them to see their prey two or three miles away.

Baby bald eagles are hatched usually in families of three. They are covered with whitish down. Nests are high above ground in tall trees or in rocky cliffs. Because the bald eagle is America's national emblem, it is fully protected by law.

A curious habit of the golden eagle is its instinct to return year after year to the same nesting site. They keep adding more sticks, twigs, hay, and grass to the nest each year until it sometimes becomes four or five feet across. Two baby eaglets are raised in each hatching.

In his fierce talons the golden eagle clutches and carries away rabbits and prairie dogs and sometimes even attacks pigs, goats and calves.

KANSAS FISH

More than 100 species of fish dwell in Kansas lakes and streams. These range from the much sought-after channel catfish, bass and crappie through drum, sunfish, mudcat and the rough fish, such as carp and buffalo.

They provide for the state's No. 1 sport. Fishing is growing in popularity every year. More than one fourth of all money spent for sporting goods in the United States goes for fishing tackle. The angler contributes to the food supply of his family and friends and gains, besides, outdoor relaxation and fun. There is some commercial fishing along the Missouri River.

Like mammals, fish depend on fertile soil, fertile water, plants and other animals. They are a link in the chain of food from the soil to man. Nutritious substances pass from the soil into the water. They provide food for tiny water plants and animals. Some of these tiny animals are eaten by small fish which in turn are eaten by large fish. The pan-size fish then are eaten by man.

Two new species of fish have been introduced into the state in recent years. They are the white bass and the walleye. Both are becoming top game fish at the state's large lakes.

FISH YOU MAY SEE

Sunfish Family

This large, gamey family includes such well-known fish as the largemouth bass, the smallmouth bass, the green sunfish, the bluegill, rock bass, white crappie and black crappie.

Largemouth Bass--The largemouth's green color and broad striped sides make him easily recognizable. His big jaw gives him his name and distinguishes him from other bass. Old "big jaws" grows to the usual size of 1 1/2 to 4 pounds in Kansas, but sometimes gets into the 9- and 10-pound class. He will strike either plugs or live minnows. He is a fierce fighter when hooked or when protecting his nest.

Mr. Largemouth makes a nest by fanning a clear spot on the bottom of a lake or stream and takes care of the eggs and offspring. When young, the largemouth feeds on insects, crayfish and such organisms, but as it grows, it prefers minnows and other small fish. The largemouth likes cool, rock-bottomed water, but also is found in weedy, mud-bottomed lakes.

The smallmouth bass is found only in southeastern Kansas and then only rarely. He is brownish in color with vertical stripes.

More prominent in Kansas than the smallmouth is the Kentucky or spotted bass, midway in size between the other two bass. It has been stocked over the state and is found particularly in the Fall, Elk, Caney and Verdigris Rivers and other streams of south central Kansas.

Bluegill--The bluegill is one of the smaller members of the sunfish family, but, ounce for ounce, probably the gamest. It is the state's most common pan fish. It is stocked by the fish and game commission because of its ability to help keep ponds and lakes in balance by feeding on insects and aquatic vegetation and providing food for other game fish.

Bluegill nests on sandy bottoms quite close together. Papa Bluegill tends the nest and the young.

The bluegill can be distinguished by its olive-green color, with greenish bars, the bright copper-orange breast and its jet black "ear."

White Crappie--The white crappie is found in lakes and backwater of streams all over Kansas. It likes lakes filled with tree tops, snags and other hiding places.

Small minnows are what it eats for breakfast, lunch and dinner. Oftentimes this fish is taken on small spinner-fly combinations. White crappie grow to a maximum of five or six pounds. The average is one pound or less.

This fish is silvery-olive, shading to green or brown on the back. It is a short-lived fish; most of them do not live more than six to eight years.

Crappie usually build their nests in deeper water than other sunfish.

Catfish Family

The blue catfish, channel, flathead and bullhead are representative of the catfish family in Kansas. The catfish have smooth, scaleless bodies and blunt, be-whiskered, "cat-like" faces. As a rule they are bottom fish, living partially as scavengers. Except for the channel catfish, most members of this group prefer sluggish streams and rivers. They have been taken on all conceivable types of bait.

Channel Catfish--The channel is silvery gray, profusely marked with dark spots. Because of its highly developed sensory system, it feeds by touch, taste and sight. Catfish eggs are deposited in out-of-the-way places, such as undercut banks and hollow logs. The papa catfish takes over the care of the nest until the young hatch.

This fish is highly regarded for its table value.

It is sometimes confused with the blue cat, since adult channels become darker in some seasons. The blue cat, a rare Kansas fish, is found almost exclusively in the Kaw and Missouri Rivers. It often attains tremendous size.

Bullhead--Yellow and black bullheads are natives of Kansas waters. The yellow bullhead is a brownish color on sides and back; the black bullhead is darker. Both have white or cream-colored bellies. In some cases the black bullhead has a yellow belly. The yellow bullhead can be distinguished with certainty from the black by its creamy white barbels or whiskers on the chin. Those of the black bullhead are dark.

The bullhead will eat almost anything and will take a variety of baits.

The young fish travel in schools, guarded by the parents, until they are an inch or two long. The black bullhead is much more abundant than the yellow.

The brown bullhead is being raised experimentally by the federal fish hatchery at Farlington, Kansas, and if found suitable, may be introduced into Kansas waters.

Flathead--This olive brown catfish, sometimes called the yellow cat, seems to prefer the larger rivers, but also is present in some lakes. Its head is broad and flat, and the tail is square or very slightly notched. It feeds largely upon worms, crayfish and other fish. It sometimes reaches an enormous size - 60 or 70 pounds. It is often caught on trot lines.

Walleye--The walleye also has been introduced recently into the deeper lakes of Kansas. This slender, fighting fish is a brassy, olive-buff color, sometimes shading to yellowish sides and white underneath. Distinctive features are the large, glassy "wall" eye, and the large, tearing teeth on both the roof of the mouth and the lower jaw. The young feed on insects, but when they reach two inches in length, begin to add small fish to their diet.

Walleye eggs are scattered over gravel, sand or lake rubbish, and the parents return to deeper water leaving the eggs unprotected.

Walleyes are stocked in Kanopolis, Cedar Bluff and Fall River reservoirs, Clark and Kingman County State lakes.

Minnow Family

Carp--This brassy colored fish is the most common member of the minnow family in Kansas. It has become so abundant that efforts are made to rid lakes and ponds of it. But the carp is good to eat and provides fun for the angler.

Carp prefer warm water and sometimes grow to a large size. They are fond of young roots of water plants and turn the water muddy rooting for them.

Most of the so-called "minnows" are small fish of a distinct family, the greatest number of which do not exceed 3 1/2 inches in length. A few species, such as the creek chub and the golden shiner, may grow to a length of 12 inches or more, while the carp grows considerably larger. Minnows are of great value in streams and lakes as food for larger game fish. They are a favorite bait of many anglers.

KANSAS REPTILES

The three poisonous snakes found in Kansas are the rattlesnake, the copperhead and the cottonmouth water moccasin.

Many people confuse the common harmless watersnake hanging on a tree limb over water or swimming along the surface with the poisonous cottonmouth. Actually, the cottonmouth is found only rarely in a small section of southeastern Kansas.

The range of the copperhead is the eastern third of the state. It is found in wooded areas, generally on hillsides where rock is exposed.

Various species of rattlesnakes occur over all of the state.

Always be sure about what kind of snake it is before you attempt to handle him or get too close. The three poisonous snakes have a pit on the their heads between the eye and the nostril and a pair of large movable fangs.

A rattlesnake can be identified by its rattles, with which it usually sounds a warning when you come near. The copperhead is not so easily identified. On its back it carries brown-colored, hour-glass markings. Its head is of a coppery tinge giving the snake its popular name.

Many myths are circulated about snakes. The hog-nosed or "puffing adder" which swells up and hisses at you is not poisonous. And he cannot spray liquid poison on you. He is entirely harmless.

Other "old wives' tales" concern the hoop snake which supposedly takes its tail in its mouth and rolls down hills; the glass snake, which, according to legend, breaks into pieces and goes back together before sundown; and the milk snake which is said to steal milk from cows. Don't believe any of these. They are all false.

Here are some remarkable things which snakes really can do. Some of them, the black snakes, can climb trees. They can shed their outer skins. They can open their mouths to swallow objects which are much larger around then their bodies. They can overpower prey much larger than themselves. The poison from the rattlesnake, copperhead and cottonmouth can kill man and large mammals.

Many of our snakes are beneficial. They eat rats, mice and gophers. You should not kill them since they are working to help the sportsman and the farmer and you.

The bull snake, black snake, blue racer and king snake are good snakes. Often some of them are guilty of eating young birds and birds' eggs. But this destructive quality is outweighed by the good they do in killing small rodent pests.

Some snakes, such as the hog-nosed snake, blue racer, black snake and bull snake lay eggs. Others, such as the garter snake, water snake and the rattlesnake, bear their young alive from eggs which hatch inside the mother's body.

Turtles You May See

Turtles act as scavengers, and they also preserve nature's balance by keeping animals and plants in check. All turtles, except the soft-shelled turtle, have bony shell-like coverings on their backs and hard plates on their undersides. When danger threatens, the turtle can withdraw into his shell and feel fairly secure. Usually turtles are associated with water. However, some forms, such as the terrapins, live away from water. Most of them hibernate or remain extremely sluggish through the winter.

Snapping Turtle--"Old Snapper" might be a dangerous customer when it comes to biting, especially when he has grown to a large size.

His beady eyes have a wicked reptilian glint. And his razor-edge beak is capable of doing bad damage to anything which gets in the line of fire of his lightning-fast attack.

The snapping turtle lives on fish, frogs and other amphibians and plant material. He probably serves a good cause as a "street cleaner" and "garbage man" of the rivers and lakes.

Box Turtle--The box turtle goes one step further in protective devices. His lower shell is hinged and he can almost completely enclose himself, eluding all enemies. The box turtle is a dry-land cousin of the water turtle. He can thrive in open fields and hedge rows. For food he hunts insects, snails, earthworms and plant materials.

Soft-Shelled Turtle--This turtle lacks the hard back covering of our other turtles. He spends most of his time cruising about beneath the water's surface or basking in the sun on some bleached log or rock. Like the snapping turtle, he also has the bad habit of biting things. He is fast and can inflict a serious wound with his sharp beak.